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editor's letter

Watch this space. Passive House Plus is set to undergo something of an evolution over the coming months, to reflect a broadening of focus. As our full title of Passive House Plus (Eco Build & Upgrade) indicates, this is a magazine about sustainable building first and foremost, but with a particular emphasis on the passive house standard. Our commitment to the passive house standard will remain unchanged, and it will remain front and centre in our publication. But passive house for us has always been a means to an end – the achievement of genuinely sustainable buildings.

This is borne out by our history. As many of our readers know, although Passive House Plus is comparatively new, my colleagues and I at Temple Media Ltd had almost 10 years experience as a dedicated sustainable building publisher in Ireland before the new magazine, and the opportunity to produce a UK edition, existed. We first published Construct Ireland in January 2003, a sustainable building magazine with a deliberately stealthy title. Our ambition from the off was to make sustainable building the norm, and our judgement was that an overtly green-sounding title would make it too easy for the industry to dismiss us at a time when quantity and speed were king, and sustainability wasn't on the radar. Nonetheless Construct Ireland covered sustainable building exclusively and tirelessly, seeking to inform and educate, to influence how the industry built for the better, and to campaign for sustainable building policy, scoring some notable successes along the way.

But as interest in sustainable building grew, it became increasingly apparent that there were problems. Many supposedly sensible and sustainable measures weren't working as expected, or were causing unintended negative consequences. The lure of the passive house standard became impossible to resist – a scientific approach built on a strong theoretical basis and extensive monitoring results to demonstrate its efficacy. And while some people may think passive house is just about energy efficiency, I would beg to differ. The standard encompasses comfort in its minimum and maximum temperature targets, indoor air quality with minimum air change targets, and latterly, renewable energy generation and aiming for genuine net zero operational energy use in the form of the new "plus" and "premium" certification classes. It's true that it doesn't directly address material sustainability – although the robustness of buildings built to the standard should ensure that they endure for generations, locking in materials and embodied carbon savings in the process – and part of the appeal of passive house to non-greenies may be its disinterest in the purported greenness of one material over another. Passive houses can effectively be built out of anything, so long as they meet the standard.

But materials do matter, as does water, biodiversity, location, building size, and other factors that help to determine a building's sustainability. I contend that we must apply the sort of scientific, evidence-based approach that underpins passive house to other aspects of green building. We may end up having to slaughter some sacred cows along the way, we may discover conclusions that challenge our preconceptions, but we will emerge with stronger arguments, greater confidence, and greater ability to deliver change. Over time, I hope Passive House Plus can play a useful role in this process.

A key catalyst for this evolution is our new relationship as the official partner magazine for the UK's largest and longest-standing sustainable building association, the AECB. It's exciting to collaborate with an organisation of such standing – and with such strong grass roots – with whom we share a common goal that can be summed up in one phrase: evidence-based green building.

Regards,
the editor

Passive House Plus is an official partner magazine of the International Passive House Association

Passive House Plus (Irish edition) is the official magazine of Éasca and the Passive House Association of Ireland

2012 Business magazine of the year
- Irish Magazine Awards

Jeff Colley: winner green leader award
-Green Awards 2010

Construct Ireland: winner green communications award
-Green Awards 2010

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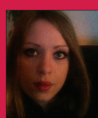
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Disclaimer: The opinions expressed in Passive House Plus are those of the authors and do not necessarily reflect the views of the publishers.

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contents


24


32


42


58


64


70

News

Passive House Plus announces AECB partnership

Passive House Plus is to become the official partner magazine of the UK's largest and longest-standing sustainable building association, the AECB (Association for Environment Conscious Building).

The announcement coincides with a planned broadening of scope for the magazine, to include more emphasis on aspects of green building that are not inherently linked to passive house, such as material impacts and water. As its full title – Passive House Plus (Eco Build & Upgrade) – indicates, the magazine has always intended to look beyond the passive house standard and into green building in general. Discussions with the AECB board have revealed a common interest in promoting an evidence-based approach to green building – applying the kind of rigour demonstrated by the passive house standard to green building generally – as a prerequisite to the widespread adoption of green building principles and practices across the UK.

Founded in 1989 by green building pioneers Keith and Sally Hall, the AECB has grown in the ensuing 25 years to become the largest green building association in the UK, with a current total of some 1200 members, including over 700 sustainable building practitioners and experts, with members ranging from housing associations and architects to construction companies and manufacturers.

The AECB's growth owes much to the establishment by Keith Hall of Building for a Future, a ground-breaking green building magazine first published in 1991. The magazine, which was latterly rebranded as Green Building Magazine, has been sent to AECB members ever since. Hall recently took the decision to cease publishing Green Building Magazine, while continuing with other aspects of his business under the Green Building Press, including a new Green Building Ezine.

In a statement, AECB chief executive Andy Simmonds, chair Peter Wilkinson and vice-chair Fran Bradshaw said:

"Green Building Magazine, and formerly Building for a Future, have for over 25 years inspired and informed a wide range of construction professionals and others interested in promoting the sustainability of buildings and the construction sector. There can be no doubt that the magazine has had a real influence over the years of its publication on many people.

"Green Building Magazine will not easily be replaced in the affections of AECB members. However all AECB members also currently receive Passive House Plus. Although some AECB members, and some subscribers, may have concerns that it is 'only about passive house', this is far from what is intended. Its editor, Jeff Colley, is passionate about all issues relating to sustainability of buildings. His previous magazine, Construct Ireland, was in fact focused on a wider range of sustainability issues. The newer publication is intended to emphasise the centrality of achieving truly low energy buildings in moving toward a more sustainable construction sector, while recognising that there are many other vital issues which we must address; hence the 'plus' in the title.

"In order to enable the magazine to widen its scope as the editor intends, and the AECB would like, the AECB will be working intensively with him over the next year or two to put much more of the 'plus' into Passive House Plus."

Passive House Plus is also a partner magazine in the UK of the Passivhaus Trust – an organisation set up by the AECB – while its Irish partners include Éasca (the Environmental & Sustainable Construction Association) and the Passive House Association of Ireland. It is also an official partner magazine of the International Passive House Association.

The Green Register celebrate 15th birthday

This autumn, The Green Register will be celebrating 15 years of sustainable construction training, membership and networking opportunities in the UK building industry.

The Green Register will hold two social gatherings (on 22 October in Bristol and 12 November in London) to mark this achievement and to celebrate with members, delegates, partners and trainers. Along with some members' stories, the group will be launching a refreshed membership offer and introducing some future partners.

There will also be a series of short, practical taster sessions illustrating the type of technical advice offered at seminars. Examples include presentations illustrating the latest technical information from Ecological Building Systems, and the Wufi dynamic condensation analysis software, together with some local, organic food and drink for all.

Lucy Pedler created The Green Register in 2000, as part of her lifelong commitment to green building. From a desk in her spare bedroom, The Green Register has grown to a nationwide organisation promoting sustainable construction practices. She said: "I am thrilled that we can hold this celebratory event open to everyone. It is an opportunity to showcase what we have achieved in the past but just as importantly, to demonstrate our exciting plans for the next fifteen years."

"The Green Register has gone from strength to strength over the past decade and a half. We are proud of our strong relationship with members and delegates, it's this dialogue which has enabled us to understand what training construction professionals need and want," she said.

Both members and non-members are invited to join the team in this celebration, but pre booking is essential. For more information see www.greenregister.org.uk

(above) Green Register trainer Cath Hassell delivering a talk on water saving to a packed audience at the Gridshell building in the Weald and Downland Open Air Museum in Sussex

News

UK's best passive house buildings celebrated at awards

Photos: Andrew Perrin

The winners of the Passivhaus Trust's 2015 UK Passivhaus Awards were announced at a ceremony in the Austrian embassy in London on 7 July. The awards aim to celebrate the design and performance of passive house buildings in the UK.

Architype was presented with the award in the 'large projects' category, sponsored by Munster Joinery, for Wilkinson Primary School in Wolverhampton, one of the firm's second generation passive house schools.

Steel Farm passive house, located near Hexham in the North Pennine Area of Outstanding Natural Beauty, was the winner in the 'small projects' category, sponsored by Kingspan Insulation. The farmhouse was constructed using a traditional cavity wall system and faced with local stone.

"Winning the award is testament to the ambitions of [clients] Trevor and Judith Gospel, and their heroic decision to build a low energy house in the challenging, yet beautiful, heart of rural Northumberland," said project architect Mark Siddall of LEAP.

Meanwhile, the Cre8 Barn at the Yorkshire Wildlife Trust's Stirley Community Farm in Huddersfield was the winner in the Ecology Building Society-sponsored retrofit category.

The Enerphit-certified project, designed and built by passive house specialist firm Green Building Store, involved the refurbishment of a derelict cow barn into an eco educational centre and space.

"We hope that the technical solutions we came up with at the project can offer a useful template for bringing historic and older buildings up to 21st century energy efficiency levels," Green Building Store director Bill Butcher.

All three projects have previously been featured in Passive House Plus, and came through against some stiff competition.

Shortlisted projects included R-Gen's Erneley Close Enerphit project in Manchester and the University of Bradford's Stem building in the large projects category; Sturgis Carbon Profiling's historic Enerphit project at 11-19 Passmore Street & passive house certifiers Warm's Enerphit upgrade of their office in Plymouth in the retrofit category; and Prewett Bizley Architects' Dundon Passivhaus new build in the small projects category.

Meanwhile the UK Passivhaus Conference takes place on 20 October at the Business Design Centre in London, with early bird tickets available till 31 August.

This year's conference will focus on two themes: scale and detail.

The morning session will explore the implications of building to the passive house and Enerphit standard at scale, including case studies on substantial non-domestic, residential and retrofit projects.

The afternoon session will focus in detail on case studies, looking at the design, construction and occupant perspective, followed by a panel discussion on what's needed to take the passive house standard forward in the UK.

Organised by the Passivhaus Trust and the BRE, with confirmed sponsors including Munster Joinery and Kingspan, the event is expected to attract in excess of 400 highly targeted delegates and over 30 exhibitors, including a broad range of companies engaged in passive house such as Beattie Passive, Green Building Store, Airflow, Ecohaus Internorm, Ecological Building Systems, Ecology Building Society, Isoquick, Magmatech, Prism Architectural, Rehau & Zehnder. The event is supported by the AECB.

For more information see www.ukpassivhausconference.org.uk

(above) pictured giving presentations on the winning projects at the UK Passivhaus Awards are Architype's Chryssa Thoua; Green Building Store's Bill Butcher and LEAP's Mark Siddall

News

SmartPly launches new airtight OSB panel

SmartPly has pledged that it is set to “revolutionise” the way timber frame structures are designed and built with the launch of the SmartPly VapAirTight structural OSB panel. With integrated vapour control properties and airtightness engineered into each panel, the company claims it is the ideal panel system for ultra-low energy buildings.

The result of three years of development by SmartPly and extensive testing at the Fraunhofer Institute for Building Physics, SmartPly VapAirTight is now recommended by the Passive House Institute as a product for providing airtightness. Each panel features alternating layers of wood strands coated with a high quality formaldehyde-free resin and wax designed to deliver total airtightness. A specialist coating is then applied to add vapour resistance and provide a premium performance OSB solution for super-insulated and passive buildings.

“OSB is assumed to be airtight, but tests prove a huge variation in performance, between manufacturers and even between different production cycles,” said David Murray, innovation manager at SmartPly. “Developed from our OSB3 system, SmartPly VapAirTight has integrated vapour control and unrivalled air barrier properties and will help to close the gap between design and as-built performance.”

Available in a standard 2397mm x 1197mm size, the panel uses a newly developed high performance coating to ensure consistently high vapour resistance across its entire surface. The smooth and durable surface has also been developed to provide superior bonding of airtight tape at panel joints. SmartPly also said VapAirTight offers excellent seal adherence to prevent air leaks, condensation and structural damage.

Manufactured from FSC-certified timber to the specification detailed in BS EN 300:2006, SmartPly said the rigid panel has been designed to be a sustainable, robust and cost-effective alternative to specialist AVCL membranes. SmartPly VapAirTight is also designed to reduce waste and man hours, as site applied, or factory applied, air and vapour control layers are not required. Suitable for both new build and renovation projects, the panels can be readily cut and fixed using standard timber frame fixings, removing the need for additional membranes, sealants and foams.

Vapairtight was recently trialled by passive house specialists Shoalwater Timber Frame on Boris de Swart of Studio D Architects own passive house build. Testing upon structural completion by airtightness specialists Greenbuild yielded a result of 0.09 ACH @ 50 PA - more than six times lower than the passive house target.

SmartPly provided nine 315 x 305mm samples of the 12mm thick panels to the Passive House Institute for testing. The edges of each sample were coated with a sealing compound to reduce the influence of the small size of the board. Testing was carried out on six of the samples, on the area of the OSB which remained inside a 200 x 200 mm sealing gasket.

According to institute scientific advisor Søren Peper: “Measurement of the leakage volume flow took place at pressures between 300 and 1000 Pa in order to obtain sufficiently high flow rates. Positive and negative pressure measurements were carried out for each sample.

The leakage of the test set-up itself was measured regularly using a completely airtight board and the result was subtracted from the measured values as an offset. Evaluation of the leakage volume flows took place with a standardised pressure of 50 Pa. After subtraction of the offset value the leakage volume flow was divided by the area of the board in order to obtain the q50-value.

The measurements – which were conducted in accordance with EN 14112 – yielded a leakage rate of 0.03 $m^3/hr/m^2$ at 50 Pa.

For more information on the new SmartPly VapAirTight panel system see www.smartply.com/products/vapairtight

(above) SmartPly’s new VapAirTight panel system, which the company claims is set to revolutionise how timber frame buildings are built

AECB condemns zero carbon homes U-turn

The AECB, the Association for Environment Conscious Building, has added its voice to widespread criticism within the construction sector following the government’s decision to scrap the 2016 zero carbon homes target – despite the subsequent ‘clarification’ by the UK energy secretary that “the decision has actually just been to ‘postpone’ the policy, rather than scrap it altogether”.

“We have always supported the zero carbon homes target as providing a driver to improved energy efficiency standards,” said Andy Simmonds, CEO of the AECB. “The target represents an important stepping stone towards best-practice fabric energy efficiency standards as practised by those currently building to AECB silver and passive house levels. It is also a vital step for the construction industry as it works towards the forthcoming EU’s nearly zero energy buildings target coming into effect in 2021.”

He continued: “We are also concerned about the effect on our members’ business. The moving of this goalpost at such short notice will inevitably have negative consequences for our members as well as for the wider construction industry. This sudden change in legislative framework will inevitably impact our members negatively. House builders, construction companies, housing associations and manufacturers, large and small, have been working towards this target for nearly 10 years and have invested many millions of pounds in putting advanced plans in place.”

The AECB is calling on its members to contact and meet up with their local constituency MPs to urge the UK government to reconsider this decision, and to lobby for radical and urgent action on energy efficiency and low energy building.

News

Econekt advances with Hampshire ICF passive house

Scottish insulated concrete formwork (ICF) specialist Econekt has recently completed work on its first passive house project — a large detached dwelling near Winchester, Hampshire. The project features Econekt's ICF and ground floor slab systems.

The ground floor comprises a raft foundation with the concrete slab floating on a base of Peripor, a dense and structural type of moisture-resistant polystyrene, delivering a U-value of 0.13. Meanwhile the ICF walls feature two layers of Neopor insulation, also a denser alternative to EPS, sandwiching a 150mm width concrete core to hit a U-value of 0.10. Econekt's Frazer McLachlan told Passive House Plus that the denseness of these types of polystyrene allow them to achieve better U-value for less thickness than traditional EPS.

The insulation in the walls and slab fully connect to create a complete thermal wrap of the structure, he explained. "It's one big insulated box that has absolutely no thermal bridges at the major junctions," he said. "It essentially is a concrete core running through the floors and up the walls that is completely insulated." The system is also inherently airtight, he added.

Econekt brought the house up to wall plate level, and also installed the concrete mid-floor and ridge beams. The ICF walls were also fitted with Rationel triple-glazed windows. McLachlan told Passive House Plus that the client is a dedicated self-builder who has prepared much of the PHPP (Passive House Planning Package) calculations himself, and that he is planning to go for passive house certification.

Econekt also recently held an open day at the house for interested parties to learn about its building system. The company is also starting on site with another passive house project in Scotland shortly.

(above) Econekt's ICF system and insulated foundation system have been used on a passive house that's currently on site in Hampshire

Saint-Gobain starts work on first 'Multi-Comfort' building

Saint-Gobain has announced the start of the first project in the UK to be built to its 'Multi-Comfort' standard. Together with Associated Architects and building contractor Speller Metcalfe, Saint-Gobain is putting the recently launched concept into practice at a new £1.2m multi-purpose school sports and drama hall.

Saint-Gobain described Multi-Comfort as "a holistic approach to constructing buildings, designed to improve occupant comfort, health and wellbeing". In making the announcement, Saint-Gobian quoted research which shows that well-designed acoustic environments in schools enhance concentration and help pupils and teachers to communicate more effectively, and that better quality environments in schools lead to increased attendance, improvements in tests scores and faster learning rates.

The 450 square metre development at King's Hawford Junior School, in Worcester, will include a main sports hall, an office, storeroom, kitchenette, toilets and changing rooms. Due for completion December 2015, The Barn, which will replace the existing sports hall, will be used for games, assemblies, drama, music and dance plus external lettings.

Multi-Comfort buildings surpass existing building regulations, Saint-Gobain said, incorporating the energy efficiency and thermal comfort of passive buildings but introducing new standards in audio, indoor-air and visual comfort to give the teachers and students an ideal place to work and learn.

Headmaster Jim Turner said: "The Barn represents a major investment for us and when it's completed it will give fantastic multi-purpose sports and drama facility for our pupils. The use of Multi-Comfort on the building will be perfect for the range of activities held there and I'm looking forward to seeing the difference it makes to the productivity and learning capabilities of the pupils.

Mark Allen, technical director for Saint-Gobain in the UK and Ireland, said: "After launching the concept at Ecobuild this year, it's great to be able to put our years of research and development into practice and see Multi-Comfort come to life.

"During the building's operation, we'll be working with the team to implement a series of monitoring systems that will collect data, which will prove useful in demonstrating the differences that both the teachers and children will experience within the Multi-Comfort building."

To follow the progress of The Barn at King's Hawford and to read more about Multi-Comfort, visit: www.multicomfort.co.uk

(above) a rendering of The Barn, the first Multi-Comfort project in the UK

News

First ‘passive house plus’ certs issued while China makes strides

The Passive House Institute has announced the certification of the first buildings in the world to its new ‘passive house plus’ standard. The first building to meet the standard was a single family home in the village of Ötigheim in southern Germany. The new standard takes into account on-site renewable energy generation as well as the energy efficiency of the building.

While a traditional passive house (now officially termed ‘passive house classic’) can have a maximum primary energy demand of 120 kWh/m²/yr, a passive house plus is even more efficient, with an upper limit of 45 kWh/m²/yr. At the same time, at least 60 kWh/m²/yr of renewable energy must also be generated – albeit with reference to the building’s footprint rather than total floor area.

The house in Ötigheim features a 64 sqm solar photovoltaic panel generating 76kWh/m²/yr of electricity on the south-facing roof.

“This building proves that creating an infrastructure based completely on renewable energy is already possible today for every building owner," said Dr Wolfgang Feist, director of the Passive House Institute.

Outside of Germany, a new housing complex in Innsbruck, Austria has become the first multi-unit residential development in the world to meet the standard.

The Vögelebichl housing complex consists of two new builds connected through an underground garage. One of the two buildings has been certified to the passive house classic standard, the other — which features a ground water heat pump, solar PV and solar thermal technology — to passive house plus.

Meanwhile the passive house standard’s global growth has continued with another breakthrough: the first office building in China to become a certified passive house – in the city of Zhuozhou near Beijing.

Call for abstracts

The Passive House Institute is calling for the submissions of abstracts ahead of the International Passive House Conference, which will run from 22 to 23 April 2016 in Darmstadt, Germany.

The institute says that a “special focus of the event will be on cost-effective systems for home ventilation, but contributions on built projects and innovative concepts for new builds as well as for retrofits are also highly welcome”. See www.passivehouseconference.org for more information.

(right) this family home in the German village of Ötigheim & multi-unit residential building in Innsbruck, Austria are respectively the first and second buildings to be certified to the passive house plus standard, while this building in Zhuozhou became the first certified passive office building in China

Photos: House: Scholz/Gerber; Apartments: Neue Heimat Tirol; Chinese Offices: Schöberl & Pöll GmbH

Detail on Irish passive house conferences announced

(left) builder Willie Moffitt describes Northern Ireland’s first certified passive house, at the Northern Passive House Chapter’s inaugural meeting at Crest

The Centre for Renewable Energy & Sustainable Technologies (Crest) at South West College in Enniskillen Co Fermanagh, in conjunction with Passive House Association of Ireland (PHAI), is hosting the inaugural Northern See the Light passive house conference on 24 September.

The event will be held at the Crest passive pavilion, a passive house and an exemplar of sustainable construction. The event is expected to be of interest to key policy makers, architects, builders, developers and building services companies. Three of the key Irish manufacturers involved in low energy building are backing the event – main sponsor Kingspan Insulation and secondary sponsors Kore and Quinn Building Products.

Session one, titled ‘passive developments’, will include talks on achieving zero carbon, the Irish building regulations, and the future of the passive house standard.

Session two, on passive and low energy case studies, will present case studies of passive house projects, including the Crest passive pavilion. Session three, on passive challenges, will include talks on retrofitting at speed, attitudes towards deep retrofit, and how to take passive house from niche to the mainstream. There will also be a free ‘beginners guide to passive house’ event.

The passive house movement in Northern Ireland has been given a boost by the formation of the Northern Passive House Chapter, which held its inaugural meeting at Crest in July.

Organised by South West College in association with the PHAI, the chapter has been set up to facilitate networking among professionals with an interest in passive house, share knowledge and encourage the wider adoption of the standard in the region. It is one of three chapters set up on the island of Ireland – the other two being in Cork and Waterford.

Meanwhile a second See the Light conference will be held in Cork at the Cork Institute of Technology on Friday, 13 November to coincide with the passive house and NZEB open days.

More information on both conferences is available at www.phai.ie

News

Petwalk brings insulated, airtight pet doors to the UK & Ireland

Austrian company Petwalk has launched its range of passive house suitable pet doors to the UK and Irish markets.

“Petwalk addresses the problem of pet entry solutions in low energy and passive houses,” the company’s CEO Klaus Kindl told Passive House Plus magazine.

Kindl told Passive House Plus that in blower door tests, the product delivers total airtightness (0.0 ACH) even at pressures as high as 600 Pascals. The door, which is made of insulating polyurethane foam, delivers an average U-value of, at worst, 0.7 W/m^{2}K, putting it on a par with some of the most energy efficient windows and doors on the market.

The door is also designed to be burglar proof and has a built-in alarm, and offers resistance class two (RC2) protection, he said.

Kindl told Passive House Plus that the door opens automatically in response to motion, but for security can be easily configured so that it only opens in response to a particular pet’s microchip, or in response to a collar tag.

The door’s appearance is highly customisable, and it can be supplied in any colour, or to match the colour or pattern of the surrounding structure. Petwalk can be installed in glazing, entrance doors or in walls. It comes in two sizes, 20 x 30cm and 30 x 50cm. For more information see www.petwalk.co.uk

(above) Petwalk’s highly insulated, airtight, automated pet doors are now available in the UK & Ireland

pro clima Intello Plus intelligent airtight system gains BBA & NHBC approval

Leading sustainable building product supplier Ecological Building Systems’ pro clima system has gained British Board of Agrément certification & NHBC approval. The system – which includes the pro clima Intello Plus intelligent airtightness and vapour control membrane – has met all the requirements set out by the BBA and the NHBC.

“This compliments the existing Irish Agrément certificate, providing specifiers, installers and homeowners with unsurpassed reassurance,” said Ecological Building Systems’ senior engineer Niall Crosson.

Set up by the British government in 1966, the BBA is the UK’s most widely known construction products certification body, offering approval and inspection services to manufacturers, installers, construction products and systems. BBA certification is only awarded after systems or products have successfully passed a broad assessment involving laboratory testing, on-site evaluations and production inspections.

“Receiving BBA certification for the pro clima intelligent airtightness system reinforces the unsurpassed standards set by pro clima in the manufacture and delivery of durable airtightness solutions which are fit for purpose and last the lifetime of the building,” said Crosson. pro clima have already received independent tests to confirm an expected lifespan for their tapes of at least 100 years.

“pro clima are pioneers not only in delivering intelligent airtight solutions, but combining this with optimum protection against condensation and mould growth by utilising intelligent membrane technology. Receiving BBA certification provides specifiers, engineers and homeowners with even more reassurance that the pro clima system will assist in delivering a robust & durable airtight result.

“Attaining NHBC acceptance for the use of Intello Plus will also prove most beneficial to homeowners, designers, timber frame manufacturers and installers.”

Crosson said that during the assessment process, pro clima Intello Plus was evaluated in a range of constructions where Intello’s unique intelligent vapour control properties provide unsurpassed safety against condensation, including unventilated flat roofs. The advanced hygrothermal simulation programme, Wufi, was used to carry out assessments in accordance with BS EN 15026, based on British & Irish climate data.

“In the development of the BBA certificate it became clear that there is still confusion on the market in relation to airtightness and its relationship with vapour control, indoor air quality and building durability,” said Crosson. To assist in addressing this, Ecological Building Systems in conjunction with the BBA will be hosting a series of information briefings throughout the UK early next year. More details will be available on www.ecologicalbuildingsystems.com later this year. The site also includes more information regarding the pro clima system.

pro clima describes Intello Plus as an intelligent membrane, differing from conventional vapour barriers and vapour checks due to an ability to become more vapour open if required. Its ‘intelligence’ lies in its ability to alter diffusion resistance levels depending on the average relative humidity surrounding the vapour check, thus ensuring that interstitial condensation risk is minimised.

(above) pro clima’s Intello Plus airtightness system

News

Learn to build a passive house in five days

Passive house build system specialists Beattie Passive is offering professionals, tradespeople and self-builders the opportunity to learn how to build passive houses at a training academy in the company's comprehensive facilities in Norfolk.

The innovative company provides a design technology that simplifies the delivery of passive house, before testing and certifying every building upon structural completion.

The classroom and predominately workshop-based course is for construction professionals, self-builders, architects, and the retrofit market, and covers all aspects of passive house build standards and the Beattie Passive build system.

The course explains the principles of building to the passive house standard and explores the reasons why this is fast becoming such a popular form of construction.

During the course delegates will learn the simplicity for the builder and the major benefits of building with the Beattie Passive system. The course provides the unique opportunity to manufacture and assemble a two-storey 27 sqm passive house structure in just a week, covering all aspects of the build from foundations through to airtightness. Qualifying as an accredited Beattie Passive engineer provides individuals with the knowledge as well as confidence to build their first passive house.

David Adams from Best Build, recently attended the training academy, "This was one of the best training courses I have ever been on – very hands-on and I learnt a lot. It also totally transformed my preconceived expectations of passive house. The Beattie Passive system is one of the best and easiest building systems I have ever seen."

For more information visit www.beattiepassivetrainingacademy.com

EcoHaus Internorm chosen as window supplier to UK's largest Enerphit project

Image: ECD Architects

EcoHaus Internorm, a leading supplier of passive house and low energy windows, has been awarded the contract for supply and installation of passive house windows at the high-profile Wilmcote House project in Portsmouth, set to be the UK's largest Enerphit upgrade to date.

EcoHaus Internorm will supply and install the Internorm KF410 Passiv window system to the development. "We were awarded this contract for a combination of cost, performance, 30 year warranty, and crucially the installation by our Internorm-trained EcoHaus installation teams," said EcoHaus Internorm sales director Mark Lineham.

Wilmcote House is the BRE's case study project under the Europe-wide Europhit programme, which is undertaking exemplar Enerphit retrofits across Europe. Wilmcote House provides over 100 homes largely in the form of three bedroom maisonettes, arranged across three blocks linked via two main stair cores. It is owned and managed by Portsmouth City Council.

Using external insulation, Wilmcote House will be split into three thermal envelopes with the two stair cores remaining outside the thermal envelopes in order to simplify the detailing required.

Each dwelling will also be provided with individual MVHR systems. Existing heating systems will be retained for the time being due to resident familiarity and budgetary constraints. Heating can be addressed as and when the current systems reach the end of their lives, in accordance with the step-by-step approach taken by Europhit. Ground floors will also not be insulated at this stage but could be considered as a future step too.

EcoHaus Internorm is the number one UK supplier and installer of windows from Internorm, the Austrian manufacturer of passive house and low energy windows.

(above) an illustration of Wilmcote House's new façade, which will feature Internorm KF410 Passiv windows, supplied and installed by EcoHaus Internorm

News

Work set to begin on Ireland's first Living Building

Leading Dublin-based green architecture practice Solearth will soon begin work on LH1, a new exemplar ecologically-advanced, energy and water plus house in the Dublin Mountains, designed for a private client.

The house will be one of the first, if not the first in Europe, to conform to the Living Building Challenge, regarded as the world's the most ecologically rigorous design and construction standard. It will be the first Living Building of any type in the UK or Ireland.

Living Buildings use nature as a model, and are designed and operated to thrive on their own site's energy and water, to be 100% healthy, to offset all their embodied energy, and to meet another 16 challenging ecological criteria.

LH1 will be of timber frame construction with U-values and airtightness to passive house levels. The house's orientation will maximise solar gain, while the design layout is rectilinear and simply formed, with a good surface to volume ratio ideal for reducing heat loss and complex junctions.

The house will feature mechanical ventilation with heat recovery, and will use outgoing warm air to heat domestic hot water, which will be primarily provided by solar thermal collectors.

LH1 will also have Ireland's first installation of Climawin's pre heating (passive heat recovery) windows, and will feature rainwater harvesting and reed beds for wastewater treatment. Work on the house was elected to begin at the end of August, and to be complete by the end of November.

(above) an illustration of LH1, which is set to be Ireland's first Living Building

Smet BIM objects among most downloaded in NBS library

Objects authored by Smet Building Products have become some of the most downloaded in the UK's NBS National building information modelling (BIM) library, with over 18,900 downloads by designers and architects since launch, according to the leading building material supplier.

Coinciding with the recent publication of the 2015 NBS National BIM Report, Smet is celebrating two years since the launch of a range of its BIM objects with the library. The company's Joris Smet said that the company was the first in the UK dry mortar industry to invest in BIM.

The company's 47 high-quality, data-rich Smet objects are listed under: bedding & underlay, plasters & renders, mortars, grouts & slurries, concrete, adhesives, and the admixtures & additives categories.

"We initially chose to host our BIM objects with the NBS National BIM Library for many reasons, including the possibility of being able to offer the authored BIM objects in all major software formats and their first-class authoring service," said Joris Smet.

"Clearly we chose wisely as two years on, this dedicated service, developed and managed by NBS, is now the go-to information service provider for designers and architects." The 2015 NBS National BIM Report found that two thirds of designers and architects turn to NBS for information about BIM.

Last year, Smet announced that all its BIM objects had been updated in Revit format in collaboration with NBS.

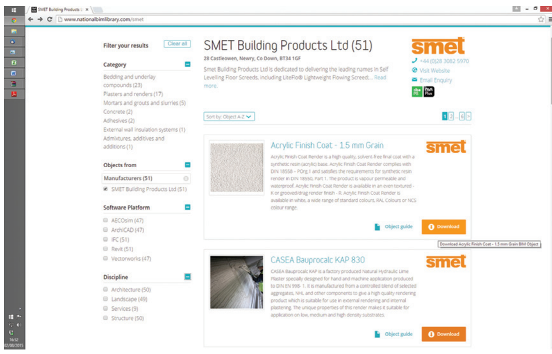
"BIM, which was once a nice to have early innovation, is clearly now a standard way of designing buildings, thanks also to the [UK] government's mandated use of level two BIM on all centrally-procured public sector projects, which is fast approaching," Joris Smet added.

"We know adopting BIM has given us a key advantage when contracts are being agreed and in many ways we are leaving the non-adopters behind.

"Moving into our third BIM year, in alignment with our company strategy, we will continue to prioritise monitoring designers' needs, invest in, and enhance, our BIM catalogue and continue to address the immediate need of designers for access to high quality, standardised, information-rich BIM objects."

A comprehensive range of BIM objects are available to download for free from www.nationalBIMlibrary.com/smet

Joris Smet also said that designers, specifiers and contractors can contact the company for assistance in their specific specification writing.



(above) Smet has 47 data-rich objects listed on the NBS National BIM library

News

AECB Conference 2015 review

*The largest green building association in the UK in terms of membership numbers, the AECB held its annual conference on 20 June in Sheffield. AECB trustee and passive house architect **Mark Siddall** reports.*

This year a tight-knit group of AECB members met in Sheffield for the annual conference. Sheffield University were hosts. After a brief introduction, Prof Fionn Stevenson, the esteemed building performance researcher and educator, offered a warm welcome to a city with more trees per person than any other city in the UK.

AECB chair Peter Wilkinson went on to set the scene. The association he noted is changing. It is strengthening its views and seeking to engage with political changes and there have been increased ties to organisations such as CIAT.

The Passivhaus Trust, an offshoot of the AECB, has continued to galvanise people's interest and the AECB Silver standard has also made some significant advances. This year alone there were 75 AECB Silver homes certified.

The Low Energy Buildings Database has continued to develop and grow. Peter also noted that there is a desire to have more female trustees on the board (so if you are an AECB member and you feel inclined to join the board please make yourself known.)

The Carbonlite retrofit standard (CLR) took centre stage. The training programme that will be used to support CLR is a bridge between 'make do' and best practice retrofit. It is about creating an adequate level of understanding rather than creating another tier of experts. In this case, so that manufacturers' data can be interpreted and challenged when appropriate, adequate understanding means being numerically literate. By creating the foundational knowledge that building professionals need it is possible to avoid long term unintended consequences that could have costly implications. Expect to hear much more about this in coming months.

Highlights of the event included practical lessons in airtightness by Paul Jennings from Aldas. This packed-to-the-walls workshop demonstrated a range of construction technologies and airtightness solutions, and used blower door fans to help determine the leaks.

Another popular talk was delivered by Nick Grant of Elemental Solutions. His subject was value engineering and it was delivered in Nick's typical no-nonsense style. Decisively separating the wheat from the chaff, he demonstrates how a true understanding of value enables quality standards to be raised, with value increased and investment costs optimised or cut.

Helen Brown from Encraft and Paul Jennings gave a presentation about a retrofit at Wilmcote House, Portsmouth. The occupants of the existing building suffer from high bills and condensation. A conditions report revealed that 80% of the windows needed to be replaced. The move to retrofit the building to Enerphit standards was the brainchild of architect Mark Elton (now of Sustainable By Design). Initial strategic PHPP models were simplified. The more detailed studies that have now been undertaken by Helen Brown have demonstrated that in practice the project cannot be certified because the primary energy demand cannot be reduced below the required threshold. Nonetheless the fabric upgrade continues to target Enerphit standards of performance. Ventilation and overheating risks are being given very careful attention.

At the close of the day there was the World Café. Here themed tables were established with a couple of expert hosts. The remaining members were free to join or leave the themed discussions as and when they chose. This latest addition to the conference proved very successful. So expect to see more of the World Café in the future.

Catrin Maby started the second day with a talk titled "From Frozen Bodied to Warm Homes." This retrospective of her career offered insight into her crusade to enrich people's lives by finding ways of taking them out of fuel poverty and providing healthier homes. Along the way Maby grew the Severn Wye Energy Agency from 2 to 45 people.

This talk was quickly followed by a tour de force that was delivered by services engineer Alan Clarke and accompanied by Green Building Store's Andrew Farr. Starting from the basics about how much fresh air is required to provide good indoor air quality, they left no stone unturned when testing and challenging common assumptions about ventilation. Along the way the audience discovered that internal moisture gains appear to be about half that predicted by design standards, that in a limited number of UK test cases humidity recovery appears to work, though it may not be suitable for small dwellings, and that with properly designed and commissioned MVHR systems cascade ventilation is surprisingly robust.

I also had the honour of presenting at the conference this year. The presentation explored the feedback from occupants that live in two certified passive house projects that I designed. The 25-unit Racecourse Estate and Steel Farm, a bespoke home featured in issue 10 of Passive House Plus and on www.PassivhausSecrets.co.uk. The biggest lesson from the presentation – the biggest lesson that I learned from this research exercise – is that architects and engineers need to think more like anthropologists and less like designers. Only then can unintended consequences be avoided.

For more details about the conference and the presentations go to http://tiny.cc/AECBconf2015

(above) Dr Tina Holt presenting on the AECB's Carbonlite retrofit standard at the 2015 AECB conference

News

New London development features Kingspan solar facade

One building in Central London is using solar thermal tubes not just to generate renewable energy but also to create a remarkable and eye-catching facade.

In marked contrast to more typically discrete installations of renewable energy technology, architect Nick Baker chose to celebrate the inclusion of solar collectors in his Camden development by placing them on the front of the building.

The striking five-storey residential building in Delancey Street features a ground floor commercial unit and 14 residential flats on upper floors, and hit level three on the Code for Sustainable Homes. In all, there are 925 Kingspan Solar Varisol evacuated tube collectors which hang in banks down the front and outer walls of the building, creating a unique and beautiful frontage which sits comfortably within a designated conservation area.

The specification for this highly bespoke renewable energy installation was done by Kingspan's in-house designers and engineers. A particular consideration was the design of the facade and the nature of the available space. While solar panels and tubes are typically laid on a flat surface, at Delancey Street the south/south-west side of the building is curved.

The curvature was overcome by placing the collector tubes within six vertical banks. A perhaps more pressing concern was the irregular space which each bank needed to exactly fill to complete the building's unique facade. Here, the adaptability of Varisol solar thermal collector tubes comes into its own, according to Kingspan. The collectors are custom-made to fill unequal or bespoke spaces through their modular design.

Normal manifold collectors hold a specific number of tubes in rigid panels, making them inflexible, the company said But the number of Varisol collector tubes can be varied to ensure that the installation exactly matches the size of the space. At Delancey Street, the final facade incorporated four banks of 175 solar collector tubes, one bank with 133 tubes and one bank with 92 tubes.

Simon Bonfield, Kingspan's specification manager, said: "The precision with which our installers could place the Varisol tubes as an integral part of the building's design was vital in this development. The result is so striking it stops traffic in the area!

"But it's not just beautiful, it's also highly effective at capturing solar energy. The scheme provides nearly 93 sqm of solar thermal tubes in total, saving more than 5,000m^3 of gas, lowering CO_2 emissions by around 11,000kg."

Photos: Ray Schram Photo

(above) a bespoke Kingspan Varisol array ensures the Delancey Street development architecturally expresses its renewable energy use

Ampack air & windtight membranes get BBA and NHBC approval

Leading passive and low energy building supplier Partel has announced that its Ampack range of airtight and windtight membranes has received British Board of Agrément certification. The certification also includes approval from the National House Building Council (NHBC).

Partel's Hugh Whiriskey told Passive House Plus that the Ampack internal and exterior systems— Ampatex DB 90 airtightness and vapour check, plus Ampatop Protecta and Aero windtight breather membranes — are covered by the new certification. The range of associated Ampack tapes is also listed as ancillary parts in the certificate.

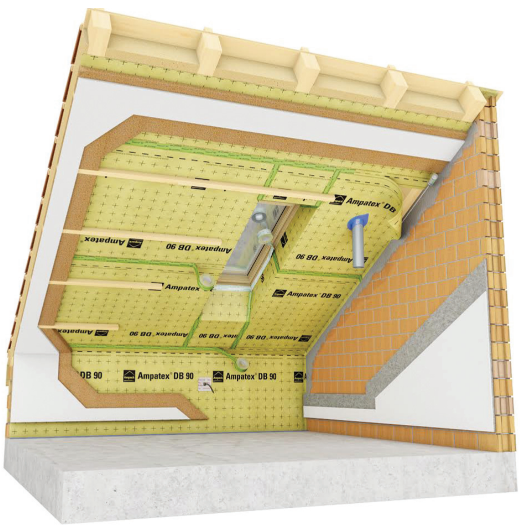
Whiriskey added that all of Ampack's external membranes are also available in a 'plus' version that includes integrated windtight tapes. Ampatop Protecta is one of the most technologically advanced and strongest roof membranes on the market, he said.

He said that the entire Ampack range comes with a unique ten year warrantee. "Ampack's guarantee covers not just the replacement cost of materials but also associated damages and the cost of any repairs, which makes it unique in the market."

Established in 1946, Swiss supplier Ampack is a market leader in building envelope protection products, and was reportedly the first company to commercially produce vapour checks. As a result Ampack has had products installed and tested for over 35 years.

Ampack have been at the forefront of building protection systems for decades and have developed a name that stands for high quality proven products, Whiriskey said. Ampack offers one of the largest ranges of airtight systems including a range of butyl, nail seal, UV stable tapes and a new SD variable membrane Variano, another innovative product with a new type of surface designed for increased adhesion.

Located in Galway, Ireland, Partel is a supplier of insulation and airtightness products including Lunos ventilation systems, Schneider wood fibre insulation and Compacfoam thermal breaks.



(above) the Ampack airtightness system, available in the UK and Ireland via Partel

News

Tyvek roof underlays meet new British standard under all conditions — DuPont

The British standard BS5534:2014 highlights the role of a roofing underlay's wind uplift resistance in protecting against stormy weather and preventing costly damage. The considerations it outlines – based on a combination of meteorological, geographical and building physics data – not only establish the minimum standards in the new code of practice, but are also essential to long term peace of mind.

But while much has been made of the importance of achieving BS5534:2014 compliance, the picture may not be quite so straightforward, according to roof membrane manufacturer DuPont. The company points out that a key part of the revised standard refers to altitudes not greater than 100m — and that surprisingly large areas of the UK are above this elevation, including Milton Keynes and big swathes of Essex, Surrey and Nottinghamshire.

DuPont said that with world weather looking increasingly unpredictable anyone specifying a membrane would do well to ensure that, like their project's roof, everything is covered by a membrane with proven reliability and compliance with all conditions, altitude included.

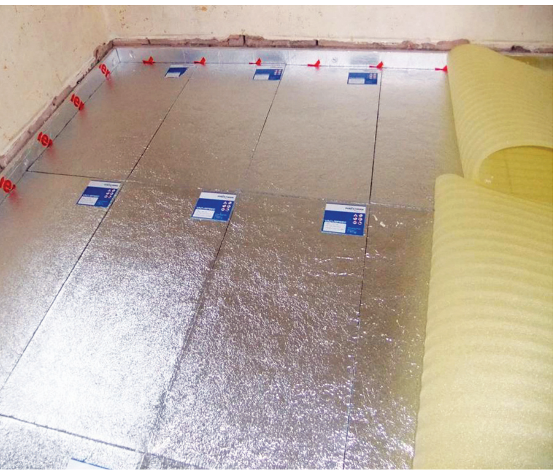
All underlays are required to clearly state, in literature, certification and on roll labels, the declared wind uplift of the material, and on this basis, the end user can determine the suitability of the material for the site's location. BS5534 splits the UK into five zones, and to be fully complaint the underlay must be able to meet certain specified levels of force. The new standard also requires compliance with the following conditions: ridge height not greater than 15m, roof pitch between 12.5 and 75 degrees, site altitude not greater than 100m, and no significant site topography.

DuPont said that while meeting all the requirements of BS5534:2014 could prove challenging for contractors looking for a reliable, easy-install, trouble-free solution, the company's Tyvek roof underlays are fully BS5534 compliant and allow unrestricted use anywhere in the UK, in all building characteristics and under all site conditions.

DuPont said its three BBA approved underlays — Tyvek Supro, Tyvek Supro Plus and Tyvek Enercor — offer unrestricted application when tested in accordance with BS5534:2014, with no counter battens required in any zone. This allows contractors to be confident that they in are full compliance, not only with the code, but with all the weathering and thermal performance expectations of an advanced breather membrane, the company said.

(above) the recent restoration of the roof of the historic St Germanus church on Cornwall's Rame peninsula included a breathable Tyvek roof underlay to protect the church from moisture during construction and prevent interstitial condensation upon completion

Vacutherm delivers high thermal efficiency for low thickness



Vacutherm's Vacupor vacuum insulation panels have helped the Erneley Close retrofit project in Manchester to achieve its passive house Enerphit certification. The development, by Eastlands Homes, comprised the retrofit of 32 maisonettes across two blocks. It was recently nominated for a UK Passivhaus award and is profiled on page 64 of this issue of Passive House Plus.

Vacupor is a vacuum insulated panel that is able to deliver excellent U-values for minimum thickness, making it ideal for retrofit projects. Vacupor was specified at Erneley Close because specifying a thicker material would have meant restricting headroom under doorways.

The Vacupor NT used at Erneley Close delivered a U-value of 0.21 W/m^{2}K for just 30mm of thickness. The thermal conductivity as quoted on the product's CE certificate is 0.007 W/mK.

"We supplied insulation to the ground floor of all the duplexes in both blocks, the panels were laid directly onto the concrete floors." Vacutherm's Simon Astill told Passive House Plus. This meant that it was not necessary to dig up the existing floors on the project.

"The panels had a foam underlay underneath and then one over the top to afford some mechanical protection during laying. Over the panels there was a floating floor fitted.

"We carried out a survey of each floor and then provided a plan of each one, so that the installers could follow this to make sure the panels were installed in the correct positions."

For more information on Vacupor vacuum insulated panels see www.vacutherm.co.uk

(left) Vacupor NT panels were installed at Erneley Close to provide low U-values in restricted conditions

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Floor area (approx. ft² or m²): ______________________

Budget (approximate): ______________________

Stage (tick box)

Initial appraisal ☐ Pre planning ☐ Planning approved ☐ Pre tender ☐ Commencement notice ☐

Project imperatives (tick box)

Certified passive ☐ Near passive/low energy ☐ Indoor air quality ☐ Low running costs ☐ Low environmental impact ☐

Other (please state): ______________________

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- Wood panel products ☐

I would like my project to be considered for feature in Passive House Plus (tick box) ☐

Why scrapping the zero carbon standard makes zero sense

*British chancellor George Osborne has announced the scrapping of the zero carbon standard, which would have required that all new homes built in the UK be carbon neutral from 2016. It's just one part of a wave of environmental rollbacks by the Tories – an approach that makes little environmental or economic sense, writes **Griffin Carpenter**.*

The supposed reason for scrapping the zero carbon standard (ZCS) by chancellor George Osborne is to promote home building. Of course housing supply is a major issue in much of the UK, but no evidence has been provided by the government to link the ZCS to a lack of housing supply.

While a lot of research on home building has looked at the UK's north-south mismatch of job opportunities and housing, as well as the role of international investment in the property market, no analyst in this space is seriously suggesting that the housing shortage is due to the ZCS, or even environmental building standards more broadly. Building standards are simply too insignificant a factor in housing supply. It is also worth noting that as the policy has been in place since 2007 any small price changes to land should have already been accounted for.

> “No analyst is seriously suggesting that the housing shortage is due to environmental building standards"

A look internationally also throws cold water on the idea that building standards are holding back supply. Compared to other developed countries (many, if not all, with a healthier supply of homes) building standards in the UK actually lag behind. Perhaps coming as a surprise to the chancellor, big names from the building industry have actually written an open letter to the government expressing their disappointment with the scrapping of the ZCS.

While the policy change will do little to change housing supply, it does fly in the face of some economic wisdom. For one, there are significant learning-by-doing and first-mover advantages to pushing ahead with zero carbon homes. There is competition between building industries by different manufacturers in different countries in Europe. While the green building industry in the UK has come out against this policy change, industry and manufacturers in other European countries are likely celebrating the change as their UK competitors now face a smaller market of zero carbon homes.

There is also the issue of carbon lock-in as homes built today will become much harder to retrofit to a zero carbon level at a later date. This problem should be crystal clear given all the effort taking place at the moment to retrofit older buildings. Even worse, there is some cost shifting taking place as these retrofits will most likely be paid for by future homeowners instead of developers. The scrapping of the ZCS will also result in higher energy bills that hit the poor hardest. This issue is only mentioned by the government when rolling back other policies like subsidies for renewables.

On the issue of future costs, it is important to remember that with climate policy we are trying to avoid much larger costs down the road in the form of climate damages. The precise link between zero carbon homes and the impacts of climate change is indirect, but the lowest cost approach given the climate risks would be to pay for zero carbon homes now rather than pay for the (potentially very serious) damages from future climate change.

One of the most troubling aspects of the government cancelling this policy is that it creates uncertainty around other government policies both in the building industry and beyond. This is hugely significant. To spur investment, in green buildings and elsewhere, policy certainty is absolutely fundamental. The government has now signalled to investors that just because a policy has a certain time frame specified it could still be scrapped at any point.

This policy uncertainty is amplified by other environmental rollbacks underway including the removal of support for onshore wind, solar and biomass, the scrapping of the ECO scheme and the Green Deal, selling off the Green Investment Bank, and the abandonment of the green tax target.

Scrapping the ZCS policy is especially troubling because the UK housing stock is a particularly key area for the government to deliver on its climate targets. The most recent Committee on Climate Change report notes that housing is an area of particular concern with falling installation rates for cavity wall and loft insulation and a shockingly flat trajectory for carbon emissions going forward. In fact, one of the three recommendations for housing in the report is to not only keep the ZCS policy but to protect the policy against the sort of exemptions that have crept in over the past few years.

Is it all bad news then for zero carbon homes and green buildings more generally? Not necessarily. In issue two of Passive House Plus, Jonathan Hines of Architype argued for zero carbon to be replaced by the passive house standard, noting that the ZCS does not sufficiently address energy efficiency and focuses too much on on-site renewables.

Whether or not the chancellor made this policy change after reading a copy of Passive House Plus, the first part of Jonathan's argument has now come true. My suspicion is that the government alone will not create an ambitious new and better standard, but there is a potential opportunity here.

First, this policy change did not come from consumers or the public directly. Scrapping the ZCS (like most of the other environmental rollbacks) was not in the Conservatives' election manifesto, and the vast majority of consumers are likely to support greater energy efficiency.

Second, while there is some uncertainty in the UK government policy, there still remains the 2020 EU requirement for nearly zero energy buildings. This policy has a more direct link to energy efficiency and in that sense provides a better opportunity to enact passive house building standards.

As is so often the case with policy rollback, a devastating change leaves an open gap where there is an opportunity for a more focused, bottom-up approach to rise to the challenge.

Griffin Carpenter is an environment economist with the New Economics Foundation (www.neweconomics.org)

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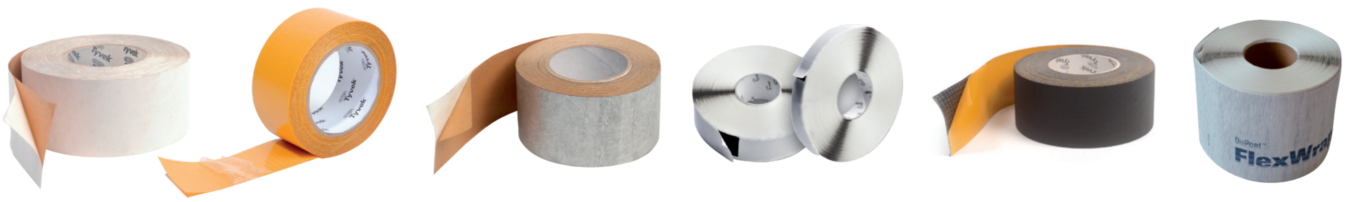

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The passive house standard can't be diluted — and here are the maths to prove it

*As debate ramps up in Ireland about whether local authorities in Dublin should adopt the passive house standard, and the UK government scraps its plans for zero carbon homes, **Dr Shane Colclough** urges passive house advocates to prepare for the lobbying battles ahead by remembering the basic science behind the standard.*

This week, I am reminded of the first meeting I had with Prof Wolfgang Feist when he met the Irish delegation attending the international passive house conference in Dresden. One of the delegation raised the point to Prof Feist that the Irish climate is mild, and therefore asked if a case could be made for reducing the requirements of 10 W/m^2 (for heat load) or 15 kW/m^2a (for space heating demand) in the case of buildings constructed to the passive house standard in Ireland.

Prof Feist paused and countered with a question himself: "What would your response be if I were to ask you if the ratio of the circumference of a circle to the diameter [Pi] could be altered?" He paused again. "Unfortunately, I have no way of changing the definition of a passive house, irrespective of the climate."

"The passive house movement's greatest strength is our ability to highlight the building physics basis & evidence-led approach of the standard"

We often lose sight of our roots and the strength of the concept of the passive house standard. Let's remind ourselves. The passive house standard is defined based on sound building physics and has as its core the objective of ensuring that occupants enjoy thermal comfort with good indoor air quality: "A passive house is a building in which thermal comfort (as defined by the standard ISO 7730) can be guaranteed by post-heating or post-cooling the fresh-air flow required for a good indoor air quality without additional recirculation."

So, at its core is reducing the space heating demand to facilitate the use of air as the heat transfer mechanism — and, if this is achieved, the traditional heating system can be dispensed with. The mathematics of the standard proposed by Wolfgang Feist are explained on Passipedia as follows:

To ensure good indoor air quality, one person needs about 30 m^3 of fresh air per hour. This supply air can only be heated up to 50C to avoid the scorching of dust. The specific heat capacity of air is 0.33 $Wh/(m^3K)$ at normal pressure and a temperature of approx. 21C. From this the heat flow can be calculated:

Heat Load: $30m^3/hr/pers*0.33Wh/(m^2K) * (50-20)\ k = 300\ W/pers$

Hence: Fresh air heating can supply 300 Watt per person. Assuming 30 m^2 of living space per person the maximum heating load at a given point of time may not exceed 10 Watt per square metre of living space – independent of the climate. As these figures refer to that day of the year where the maximum amount of heat needs to be supplied to the building (heating load), passive houses require different levels of insulation depending on the individual climate: more insulation in extreme climates, less insulation in milder ones.

So, at the air change rate required to ensure good indoor air quality, air can be used to heat a dwelling, thereby eliminating the need for a conventional heating system. This was the concept in all its purity proposed by Wolfgang Feist, and the contribution to the world-wide body of knowledge which gained him his PhD.

The real beauty of the passive house standard is that the sound theoretical basis on which the concept was founded has not only been proven with the dwellings built in Darmstadt, but has also been reinforced by countless other academic publications and studies such as the CEPHEUS ('Cost Effective Passive Houses as European standards') study where hundreds of houses have been monitored and results reported on. This enables the evidence-based approach which is the bedrock of the passive house standard.

When Wolfgang Feist answered the Irish delegate comparing the definition of Pi to the requirements to achieve 10 Watts per metre squared to meet the passive house standard, he reminded me of the beauty of maths and the elegance of his solution.

As we enter the fray of discussions about the adoption of the passive house standard in Dún Laoghaire-Rathdown County Council and Dublin City Council, and elsewhere, we must always be mindful of the sound theoretical basis on which the passive house standard is founded. While others have opinions on the best approach to achieve near zero energy buildings and meet the building regulations, the passive house movement's greatest strength is our ability to highlight the building physics basis and evidence-led approach of the standard which must remain at the core of all that we do.

Due to this sound theoretical basis and evidence-led approach, we know that passive house occupants will benefit from good indoor air quality, good thermal comfort and the virtual elimination of fuel poverty.

This makes it all the sadder to see the success of the various lobby groups in their obfuscation of the truth, and success in getting environment minister Alan Kelly and housing minister Paudie Coffey to instruct the four Dublin local authorities not to introduce tougher building standards locally.

The only reason I'm involved with the Passive House Association of Ireland is a firm belief in the ability of the passive house standard to make a real contribution to the welfare of our citizens. When I bought my home, I simply trusted that the house was as it should be. Had I the knowledge of what a passive house is, and had the option to buy one, without doubt I would have been living in a passive house for the last 20 years.

As a group of industry professionals, we have a moral obligation to do all we can to ensure the passive house standard is adopted in Ireland, and that we must do all in our power to ensure that the right decisions are made on behalf of the citizens of Ireland, irrespective of the might of the lobbyists. The truth is on our side. Pi is and always will be 3.14159265……

Dr Shane Colclough is chairperson of the Passive House Association of Ireland.

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INTERNATIONAL

Photos: Jucko Prawito / Austrian Embassy Jakarta & Timothy / Austrian Embassy Jakarta

Austrian embassy, Jakarta, Indonesia

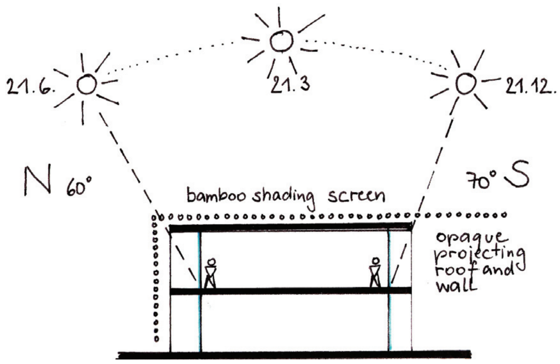
The new three-storey Austrian embassy in Jakarta, located among the traditional villa-like buildings of the city's Mentend district, was designed by POS Sustainable Architecture to fit neatly into the neighbourhood while embracing contemporary sustainable design. To this end, the front entrance makes extensive use of bamboo, there is an emphasis on local and natural materials like stone and timber, and fabrics on the internal walls echo Indonesia's rich textile tradition.

The cavity-wall building is home to ten offices plus meeting rooms, a conference room, garden terraces and green spaces. In such a hot climate, the embassy only needed double glazing to meet the passive house standard, though careful condensation risk analysis was required. The embassy achieved a final airtightness figure of 0.4 air changes per hour, crucial for mitigating the entry of humid air into the building fabric.

The embassy's cooling load is provided by concrete core temperature control, or CCTC — pipework that is incorporated in the building's concrete structure. Average indoor conditions of 25C, 60% humidity and a constant supply of fresh air from the heat recovery ventilation system create a healthy indoor space for the building's occupants. Meanwhile the building is expected to use 85% less energy than a typical Jakarta office, while 96 square metres of solar photovoltaic panels cover almost one quarter of its electrical demand. ▶

SELECTION

This issue's international selection features an embassy in Indonesia, an educational building in South Korea, an experimental solar-powered house in France, and social housing in Philadelphia.



Lohas Academy, Goesan, South Korea

Photos: Vallentin Architektur

This passive-certified extension to the Lohas Academy is located on the edge of a nature reserve outside Seoul, amid rice paddies, woods and rolling hills. The client, Pulmuone, is Korea's largest producer of health food products, and the academy serves as an educational centre for the company to teach young people about nutrition and sustainable food production.

Designed by German architects Rena and Gernot Vallentine, the centre features classrooms and kitchens, guest apartments and open plan common spaces. The building modulates its shape along the rounded hills behind it, and opens up towards the adjacent valley. The main link between nature and architecture is the accessible roof garden, designed to fit naturally into the surrounding landscape, while all parts of the building are designed to provide easy access to the outdoors.

The building's walls and roof were built with reinforced concrete that's insulated with cellulose, while the walls feature a ventilated timber facade. The building scored excellent airtightness of just 0.17 air changes per hour. Meanwhile all rooms are equipped with underfloor heating — important because Koreans normally sit, eat and sleep on the floor.

While the cold and snowy winter in Korea is quite comparable to that of central Europe, the summer is hot and humid. In summer mode, the underfloor heating uses cold water to provide cooling, while there is an additional ceiling-based cooling system in some of the larger rooms. A de-humidification module in the ventilation systems also pre-cools incoming air during the warmer months. ▶

Photos: Techstyle Haus © Domaine de Boisbuchet, photo Julia Hasse 2015

Techstyle Haus, Lessac, France

The challenge for this project's designers was daunting: create a highly efficient solar-powered house from scratch, build it with materials that have never been used before in residential construction, then get the whole thing to France for an international competition.

Techstyle Haus is a self-sustaining solar home built by students from Rhode Island School of Design, Brown University and University of Applied Sciences Erfurt in Germany for the 2014 Solar Decathlon Europe. The competition challenged 20 university teams from all over the world to build efficient, comfortable and sustainable solar homes.

Techstyle Haus's gracefully curved exterior shell is made from a flexible textile material supported by steel structural ribs. The material, Sheerfill II architectural membrane (a fibreglass membrane coated in teflon), is generally used on the roofs of domed sports stadiums and airplane hangers, but has apparently never before been used in residential construction. The textile walls were insulated with mineral wool, and also feature Isover Vario vapour membranes and Saint-Gobain triple-glazed windows.

When the outside temperature rises, phase-change materials in the house's mechanical core change from solid to liquid, trapping unwanted heat in the process. When the temperature cools, the materials solidify, releasing that trapped heat to keep the house warm.

The house features air-to-water Viessmann and Daikin heat pumps for heating and cooling, Viessmann heat recovery ventilation, 24 square metres of electricity-producing solar PV and six square metres of solar thermal collectors for hot water. Meanwhile, greywater from sinks, showers and appliances is filtered and recycled to irrigate the gardens outside.

Techstyle Haus finished third in the 'comfort conditions' category of the Solar Decathlon, and came 14th overall. Built to the passive house standard, it hits key targets for space heating demand (13.3 kWh/m^2/yr) and airtightness (0.6 air changes per hour). The building now provides student accommodation at Domaine de Boisbuchet, a centre of art, architecture and design in west central France. ▶

Photos: Sam Oberter

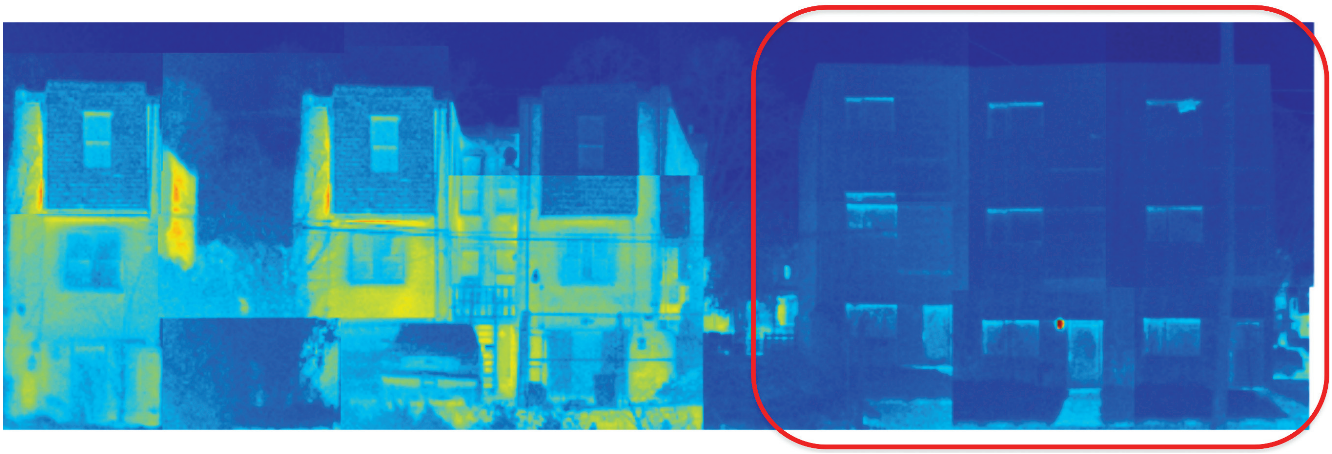
Belfield Homes, Philadelphia, USA

Design and build firm Onion Flats wasn't even asked to meet the passive house standard for this residential social housing project in Philadelphia, which was completed in 2012 — only to build it on time and on budget.

But the firm saw it as an opportunity to show that sustainable housing needn't cost more than standard construction. The team was also keen to develop a system of building passive house that could be easily copied and scaled up in future.

The development features three homes built for formerly homeless families. The building is of modular timber frame construction, insulated with cellulose and PIR board. Triple-glazed windows from Irish manufacturer Munster Joinery sit flush with the airtightness membrane to create a simple airtight seal.

These were the first passive house certified homes in Philadelphia, with a space heating demand of 14kWh/m^2/yr and airtightness of 0.4 air changes per hour. But surprisingly, Onion Flats found that in one month (February



2013) energy bills for the three units varied between $72 and $226. How to explain this huge difference?

It turns out the that the home with the highest bill was doing, on average, 104 loads of laundry in 30 days — essentially it had become an ad hoc laundrette for the tenant's friends and family (the non-profit that manages the building doesn't charge tenants for electricity).

But when electricity produced by the rooftop PV panels are factored in, bills average between $32 and $93 per month for all utilities.

Want to know more?

Click here to view additional information on these projects, including an online gallery featuring illustrations, photographs, and project overview panels.

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Is this the UK's **greenest building?**

Photos: Dennis Gilbert, Morgan Sindall & Architype; Construction photos: Darren Carter / Morgan Sindall

This summer, work was completed on the Enterprise Centre at the University of East Anglia, which might just be the most sustainable large building ever constructed in Britain.

Words: Ben Adam-Smith

The backstory to the Enterprise Centre at the University of East Anglia (UEA) in Norwich, arguably started many years ago in the line of UEA buildings that pushed the boundaries when they were built. UEA's continuous improvement programme is evident as a physical story, which paves the way to what must be their greatest achievement yet.

John French, CEO of the university's Adapt Low Carbon Group and project director, joined UEA in 2008. French was eager that the next generation of buildings at UEA should move away from high thermal mass and a dependence on carbon-intensive concrete, towards natural and locally sourced materials.

But UEA's ambitions didn't stop there — they wanted to achieve the highest standards across the board.

French says: "I was concerned that we could end up with a very low embodied carbon building, which was what we wanted, but not necessarily ▶

The thatch cladding is perhaps the most distinctive feature of this building; three hundred panels were manufactured and thatched off-site, and the panels then hooked onto horizontal battens lining the perimeter of the building. The building also features a wide array of other sustainable materials including recycled timber finishes, wood wool acoustic boards, spray-on cellulose, and wall coverings made from hemp, nettle fabric and reeds

achieve high levels of performance. So we looked around and we decided after much consideration that we would adopt the passive house standard."

The brief set the bar extremely high, demanding a minimum of 70% bio-based materials, a threshold for embodied carbon, passive house certification, a Breeam Outstanding rating, and local sourcing and supply of materials. Stepping away from UEA's routine procedure of appointing an architect to design a building and then putting it out to the market to see who could build it, the university decided to appoint a single-point delivery contractor and to hold an architectural design competition.

"All the entities that were bidding had to provide us with a good financial plan, a good low carbon and energy plan and a good architectural design," explains French. "They had to put in all that simultaneously to win the commission."

Morgan Sindall was appointed as the single point deliverer, and the company worked alongside project architects Architype on the building design, passive house modelling and embodied carbon plan.

It's important to note the level of collaboration that this project demanded and achieved. Everyone bought into the ethos of performance with minimum environmental impact and worked closely to innovate around numerous practical obstacles.

No stone was left unturned during the design process. UEA's Climate Change Unit looked at the future impacts on the building with an increase in temperatures and extreme weather events. This informed the design, most notably shading.

Gareth Selby, an associate at Architype and passive house designer on the project, says: "Life cycle carbon was one way to sum up the operational carbon and the embodied carbon. Everything was assessed with that attitude rather than just looking at how good is it for passive house. It was bringing the two together."

Domestic hot water was the biggest challenge when it came to the building's life cycle carbon emissions. At first there was a lack of data available on how much hot water university buildings use, and inputting occupancy info from other building types immediately put the Enterprise Centre over a primary energy demand of 120 kwh/m^2/yr, the maximum allowed under the passive house standard.

Selby explains: "The hot water usage and how we dealt with it became a critical issue. Fortunately UEA had done post occupancy analysis on the Elizabeth Fry Building and Thomas Paine Building. We were then able to data mine those projects and try to estimate what the actual hot water usage was, both in terms of energy and litres of hot water per person. So there was a blended analysis to come up with the figures."

The team also worked with UEA to drive down the amount of power usually specified for rooms such as lecture theatres.

The project also had a welcome visit from Passive House Institute founder Dr Wolfgang Feist, who was able to cast his eye over some of the plans. One quandary that coincided with his trip was whether to connect the Enterprise Centre to the university's district heating and combined heat and power (CHP) network.

The network was some distance from the building, and with heat loss on the pipe runs there was a cut-off point after which it would not be worth connecting. Feist offered practical input, suggesting that as the university was invested in its district heating network, and were maintaining and managing the system, it probably made sense to connect.

As with any construction project, it was essential to keep a close rein on costs. French pinpoints this as the biggest obstacle along with keeping the project 'on mission.' In autumn 2013 French faced some tough decisions that could ultimately have led to sacrificing performance criteria to keep costs in check.

"Right in the middle of what's politely called value engineering," French reflects, "when you've been presented with a finely tuned design and you've also been presented with the fact that the cost is way off where you predicted it to be, so you either go back to the drawing board and scrap the whole scheme or you have to find a way of delivering it on budget." ▸

At one point, going for the passive house standard was even in jeopardy because to take that out would have cut costs, but the whole team worked together to get costs under control.

"The building was designed for a 100 year life span, and is expected to be responsible for less than 500kg of CO_2 per square metre over this time."

Changes such as manufacturing the trussed timber roof system off site and replacing the lecture theatre's steel frame with a timber truss system helped to save both money and carbon.

French continues: "Through very good team working and incredibly effective architects practice... Architype have been brilliant in helping us find solutions to get passive house at a sensible cost."

The Enterprise Centre is of timber frame construction. Having previously developed a relationship with Irish timber frame manufacturer Cygnum on their passive house schools, Architype was confident it could fulfil the demand to source the timber locally.

John Desmond, managing director of Cygnum, says: "With the aid of Morgan Sindall I was able to meet with the Forestry Commission and determine what type of wood was available locally in their forest, which was predominantly Corsican Pine."

It's common for British timber to be used for lower grade applications, while a supply for construction is typically imported from Scandinavia.

Desmond continues: "I met with a local timber processor and was able to agree a model that would allow them to take in Corsican Pine logs, process them and was able to organise to have the processed timber kiln dried and graded in Ireland."

Despite the timber heading to Ireland and back, Desmond says it was still an effective solution compared to importing form Scandinavia. It helped to fulfil the low-carbon brief and demonstrated that it is possible to use locally sourced timber for more demanding purposes.

But producing the timber frame was still quite technically demanding. "In effect we're producing ▶

Triple-glazed Protec windows allow natural light into the building, illuminating the many natural materials and surfaces; (p37, clockwise from top) the Cygnum timber frame structure, primarily made of locally grown pine; the Siga Majcoat wind-tight membrane on the roof provides protection from the elements while being breathable; the Isoquick insulated foundation system that eliminates thermal bridging; the building's 480 square metre rooftop solar photovoltaic array

a 3D jigsaw with thousands of components," Desmond illustrates. "Getting every one of those components to work structurally and architecturally is what it's all about."

In 2014 the project went onto site. James Knox, senior engineer for single point deliverer Morgan Sindall, explains how things differed to most projects: "There are many different materials that we're not used to using and completely innovative materials on the project which have never been used before. The low-carbon concrete, for example, was designed specifically for this project and the thatching method, which our team conceived, is a world-first." The concrete makes substantial embodied carbon reductions, replacing 70% of Portland cement with ground granulated blast furnace slag (GGBS), a fine ash created as a by-product of the steel smelting process, along with with recycled sand and certified responsibly sourced aggregates.

The thatch cladding is perhaps the most distinctive feature of this building. But the ancient craft of thatching is time-intensive, so a more modern approach was needed.

Morgan Sindall proposed the idea of off-site manufactured thatch panels that could be delivered to site and lifted into place. Working together with master thatcher Stephen Letch, they created a sample on site and mocked up how the panels would be fixed. Then, three-hundred panels were fabricated at a local joinery shop and sent to Stephen's barn to be thatched.

Morgan Sindall's James Knox says: "Normally over the winter period he doesn't really have much work on. We gave him and four other thatchers a couple of months' work while it was wet, windy and snowing outside. He was working in the warm, pre-thatching our panels off-site."

This worked well. The panels hooked onto horizontal battens lining the perimeter of the building. As all the panels weren't identical, they were delivered to site in a special sequence. Once attached to the building they were trimmed in situ or given a 'haircut' if needed.

Knox was also the passive house champion on this project, which achieved a superb final airtightness test of 0.21 air changes per hour at 50 pascals.

"If there was anything we weren't 100% sure on with regards to passive house, he'd [Selby] come out and brief us on it," says Knox. "We had a passive house induction presentation he gave to us and in turn we gave the same to our supply chain as and when they were inducted."

The Enterprise Centre was completed in June 2015. The building was designed for a 100 year life span, and is expected to be responsible for less than 500kg of CO_2 per square metre over this time. Knox commented: "The quality of the finished article is one of best I have ever worked on."

It seems that this is a view that is shared not only by those who've been working on the project but those who are now using the building.

John French observes: "Everybody who's using the building now absolutely loves it. The feedback on how the building feels to the user, the ethos, air quality, natural materials, the spaces we've created. Everybody is completely wowed and blown away by the building."

Gavin Napper, Morgan Sindall area director, adds: "This is a building which is deeply rooted in its surroundings. Our team's commitment to using indigenous materials, like reed, clay, and hemp, coupled with its focus on utilising local suppliers, contractors and craftspeople, gives the building a real sense of identity and enhances its connection to Norfolk."

The story of the Enterprise Centre is far from over. It will take several months to optimise the building's performance, and in-depth performance monitoring and analysis is planned. The project may also be the first in the UK to track almost every square millimetre of timber used, along with many other aspects. These findings will all be published in due course.

SELECTED PROJECT DETAILS
Client: University of East Anglia
Single point delivery & contractor: Morgan Sindall
Architect: Architype
M&E, structural & acoustic consultants: BDP
Lifecycle cost analysis: BSRIA
Landscape: Churchman Landscape Architects ▶

Timber frame: Cygnum
Insulated foundation: Isoquick
Cellulose insulation: PYC Insulations
Windows & curtain walling: Protec
External doors: Raico
Roof windows: Fakro
MVHR: Swegon
Gypsum plaster: British Gypsum
OSB boards: Smartply
Wood fibre insulation, earth & clay plasters & natural paints: NBT
Airtightness products: Siga
Thatcher: Stephen Letch
Timber cassettes: Fox Joinery
Spruce ply: Wisa Plywood
Cellulose acoustic finish: Sonaspray
Acoustic panels: Troldtekt
Wood finishes: Osmo Oil
External grade MDF: Medite Tricoya
Lime renders: Baumit
Recycled rubber flooring: Jaymart
Hemp & nettle fabrics: Camira Fabrics
Recycled glass screed: Ecoscreed
Low carbon concrete: Lafarge Tarmac
Recycled sand for concrete: JT Few
Natural linoleum: Forbo
LED Lighting: Fagerhult
Rainwater harvesting: Pipex PX
Solar PV & bitumen roofing: Bauder

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PROJECT OVERVIEW:

Building type: 3,400sqm (gross internal floor area) detached two-storey timber frame enterprise centre/ business hub

Location: University of East Anglia Campus, Norwich

Completion date: June 2015

Budget: £11,600,000

Passive house certification: pending

Space heating demand (PHPP): 8 kWh/m²/yr

Heat load (PHPP): N/A

Primary energy demand (PHPP): 115 kWh/m²/yr (figure may improve further once the efficiency of UEA's CHP network is incorporated)

Environmental assessment method: Designed to Breeam Outstanding

Airtightness (at 50 Pascals): 0.21 ACH

Thermal bridging: Thermal bridging was modelled where glulams sat within the cassette (2 locations only). In all other areas a minimum 200mm insulation band was maintained. The following steps helped to achieve this: timber construction throughout, insulation under slab used as formwork, larsen truss zone in the timber frame to create a continuous 200mm duvet layer, overhangs created by cantilevering glulam beams on top of the roof deck rather than in the i-joist zone, mid level bride soleil is fixed to the facade breather/ sheathing board zone via a stress plate so it does not penetrate the duvet zone, high density insulation used to form door thresholds, high density insulation used to support ground floor glazing directly.

Ground floor: Raft foundation with 250mm Isoquick slab underneath. U value: 0.128 W/m²K

Walls: Cygnum factory-built timber frame featuring, from the outside in, cladding on battens and counter battens (cladding consisting of either thatch cassettes, recycled chemistry lab tables, Medite Tricoya, Baumit lime render or reclaimed oak from local council felling, Sarket breather board. 200mm larsen truss with Warmcel insulation (blown cellulose), 140mm structural stud zone insulated with Warmcel, 18mm OSB3 airtight layer, 50mm service cavity zone, Birch faced ply, lime render or timber slats to internal surface. U value: 0.122 W/m²K

Roof: Cygnum factory-built timber frame with (outside to in): Bauderflex bituminous roof membrane, 25mm ply deck, ventilation zone, Siga Marcoat breather membrane, 15mm breather sheathing, 300mm I-joist fully filled with Warmcel insulation, 18mm OSB3 airtight layer, 2 x layers of 15mm Soundbloc plasterboard. U-value: 0.132 W/m²K

Windows: Protec aluminium/timber composite windows. Overall U-Value of 0.77 W/m²K, G-value 0.49. Doors are Raico Frame + Passive House Institute certified units with overall PHI certified U-value of 0.8 W/m²K. 6 x Fakro DEF DU6 electrically-opened flat roof windows. Triple-glazed 120x220cm units, with a U-value of 0.81 Wm²K.

Heating system: Custom built heat interface unit linked to UEA's district heating and combined heat and power network

Ventilation: 3 x Swegon Gold RX Passive House Institute certified MVHR units with efficiencies ~85% using thermal wheel. Auditorium AHU also fitted with cooling coil with condensers in exhaust air duct.

Electricity: A 49.6 kW 480 sqm Bauder solar photovoltaic array, divided between 160 modules, predicted to generate 43.58 MWh in the first year.

Green materials: Low carbon concrete using 70% GGBS & recycled sand, recycled sub-base from local demolition, most timber for framing sourced from local forest, local larch used for glulams, lift shaft made from cross-laminated timber, domestically sourced OSB, local straw used for thatching (and by-products used for local flour and beer production), external grade MDF for courtyard cladding, Iroko cladding from old lab desks at UEA, recycled reception desk, wood wool acoustic sound boards, spray-on cellulose acoustic finishing treatment, recycled car tyre flooring, solvent free natural-based paints and oil finishes, ecological wall coverings (including hemp, nettle fabric, earth board, reed boards), low maintenance and long life diamond-ground concrete floor (incorporating low carbon cement), upper floors finished in Marmoleum (linseed and hessian matting on recycled glass screed).

5 years in a passive house

The occupants' view

In April 2010, Geoff and Kate Tunstall moved into their pioneering house at Denby Dale. It was one of the UK's first passive house projects, and the first to be built with a traditional British cavity wall system. Five years later, how are the Tunstalls finding life in a passive house?

Words: Geoff & Kate Tunstall

When we set out to build a new house, we had a number of goals. We wanted a home to retire to, and we wanted to downsize. We wanted a house that was comfortable, healthy and easy to maintain. In terms of design, we wanted it to be full of light, contemporary and fairly minimal. And in terms of its impact on the environment, we wanted something with lots of natural materials that consumed little energy and water. We had a terraced cottage in Denby Dale, and we had a large garden. So we decided to build the house at the bottom of the garden — luckily the orientation was perfect, just slightly off due south.

We wanted something that would be very high performance, but we only had a modest budget of £150,000. At the start, we were going down the route of focusing on renewables and other technologies. Then we went into Green Building Store one Friday afternoon to look at windows and sanitaryware, and we talked with (operations and construction director) Bill Butcher. He said: you don't want any green bling, what you need is a passive house.

As part of our research we went to visit a couple of passive houses in Austria. It was outstanding. We immediately noticed how warm it was inside, and how fresh the air was. We looked at each other and immediately said: yes, this is what we want. We brought lots of passive house books and information back with us to the UK. Remember this had never been done in Britain before, it was all a step into the unknown.

Early on we had to go into negotiations with a local builder over a 'ransom strip' at the bottom of our garden, which we ended up biting the bullet and paying £18,000 for. But the delay gave Bill and Chris Herring at Green Building Store time to do loads of drawings and perfect the design, so consequently the build went very smoothly. The whole project team had a meeting on site every three weeks — these were crucial to the success of the project.

We were very hands on during the build. We went for cavity wall construction because it was tried and trusted, and because Green Building Store had built the Longwood low energy house in the 1990s with a cavity wall system, so they had experience with it.

But in the early days, after we first moved in, we didn't know how to run the house properly. It was a steep learning curve and it took us a while to work it all out. During the build we couldn't find a small enough boiler for the house. The smallest available was 4kW, when we only needed 1.1kW. As a consequence, in the first six months there was a problem with the boiler 'cycling' (switching itself on an off) due to the small amount of water in the central heating system (as there is just one radiator and two towel rails to heat the house). The first winter was very cold and often we just turned up the heating full blast and as a consequence the house sometimes overheated up to 26C in the upstairs rooms. At the time we didn't understand that given the thermal mass of the house it heats up slowly, but once you realise it's hot and turn the heat down, it takes a while to cool down again. Once you understand how the house works it's much easier to control.

Another issue in the early days in winter, was low humidity and dryness. Geoff would wake up, when the atmosphere was drier, with a dry throat. It was only after re-reading the MVHR manual, written in translated German and not always easy to follow, that we realised lowering the fan speed helps to retain humidity. On hot summer days, we now use 'Mediterranean purging' (opening windows at night to cool down the building, and closing them during the day to prevent warm air coming in) to moderate temperature increases.

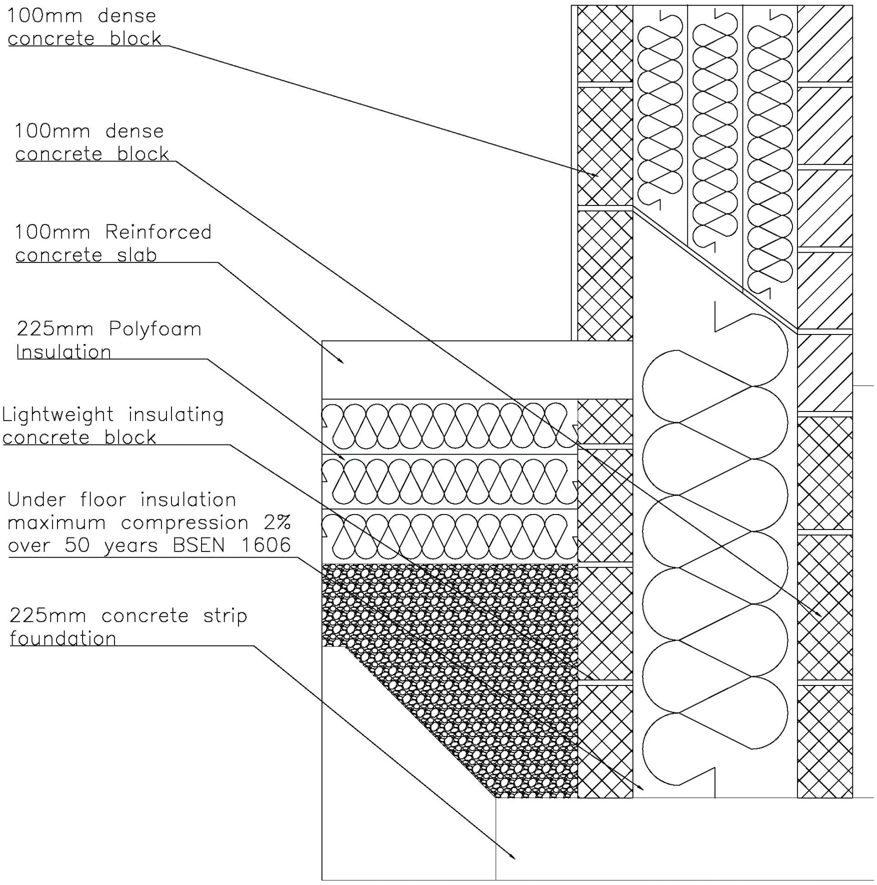
Because of the 'cycling' and lack of control over the boiler, we actually turned it on and off completely at certain times. We were able to make significant savings straight away by doing that. But then Green Building Store installed a new operating system which means the boiler is regulated much better now. This new operating system works by controlling the boiler more accurately — the only downside is that it can't take into account the effect of passive solar gain on internal temperatures.

Still, the boiler is now much more manageable. (On one of their more recent projects, the Golcar Passive House, Green Building Store has used a thermal store in conjunction with the boiler, which means there is a much bigger volume of water and no danger of the boiler cycling).

There was a teething issue with the MVHR (mechanical ventilation with heat recovery) system too. Andy Farr (Green Building Store's MVHR technical manager) came to visit us early on and found there was no fresh air coming into the house at all. He asked how we'd been feeling, and whether we were tired, but we hadn't noticed anything. He then found that a thin grille on the outside of the inlet duct was clogged up with seeds and leaves from the garden. He immediately removed the grille and the system worked fine (suffice to say Green Building Store no longer use those grilles on its MVHR systems).

Otherwise, because the house is based on a fabric-first approach and most of the technology has gone into the building itself (in term of insulation, airtightness, low cold bridging), there aren't many things that can go wrong. The house runs itself. Whatever we do to it, the house runs along performing perfectly, hour after hour, day after day, year after year. If a house is built properly, which this one is, you don't have to do much with it, and the only tweaks we've made have been minor.

Much of passive house design is subtle and under the radar, it's not bling bling. We're so used to the comfort now we don't notice it, it's the norm. We don't have to think about it. We have been in the house for five years now. In ▶



winter or summer, the house is a warm and comfortable 21C inside, whether it's minus ten or plus 24C outside.

When people come to visit the house and ask us what's it like to live in a passive house we say: "you tell us – you're sat in one – what does it feel like?" You have to experience a passive house for yourself to understand how it's different. It has an ever-so-comfortable environment that is steady and unchanging throughout the house. There are no draughts or uneven temperatures.

In many ways it's spoilt us for other houses. When we go away to someone else's house or a hotel, we love to come back and walk back into this comfort again. We went away to a country cottage in Cornwall a couple of years ago. It had thick stone walls and was draughty and bitterly cold. We were feeding money into the electric fire and we were thinking: what are we doing? Moreover, not only is Denby Dale extremely comfortable, it's also a healthy house because the air is fresh and continually changing, and is filtered by the heat recovery ventilation system.

We think that the PHPP software used to design passive house buildings should stand for Passive House Performance Prediction (instead of Passive House Planning Package), because it is such an accurate predictor of building performance. PHPP modelling has been fundamental to achieving a realisable goal of a comfortable, cost-effective, affordable, healthy home.

We reckon that it costs us around £120 a year for heating. If you look at the cumulative cost over five years, that's £600 to heat the house – some people could be paying that for six months of heating bills.

Including electricity too, our total energy bill comes to about £500 a year, but we get about a £500 feed in tariff from our solar PV system, so our net energy cost is approximately zero, which is amazing. In our old house we were paying £1800 a year for all the energy bills, so we've made massive savings. There's also the sustainability side of it — we're using a fraction of the fossil fuels that we were in our old house.

The MVHR system is working well now and is running smoothly twenty-four seven. The only time it goes off is when we change the filters twice a year. Filters cost about £60 a year, so we have spent around £300 over the last five years to keep the MVHR system running efficiently.

We always wanted to make the Denby Dale passive house available to visitors as a resource. We've had at least 500 people through the house over the last five years, at passive house open days and at other times. Visitors have included shadow ministers, US passive house designers, schoolchildren, university students, building apprentices, self-builders, co-housing enthusiasts, architects, builders, and local councillors and MPs.

We hope that these visits have helped people on their passive house journey, just as we were helped when we first visited passive homes in Austria. It is really important that people get to experience the comfort, warmth and air quality of passive house buildings first hand to help spread the word.

We have noticed changes in awareness of passive housing over the last five years. At first visitors used to ask 'what is passive house?' But now more and more visitors already understand what it's all about, echoing a shift in awareness in both the construction industry and among the general populace.

We are convinced that passive house will ▶

(from top left) A cross sectional drawing of the foundations and ground floor; insulated blocks were used on the inner leaf below the floor slab to minimise any thermal bridging, with natural Yorkshire stone externally and a 300mm cavity filled with EPS insulation below DPC & 3x100mm Knauf DriTherm fibreglass insulation batts above with Ancon TeploTies to minimise thermal bridging; (below) continuity of insulation in the roof space, helping to cut out a thermal bridge; (p47) rather than permanent brise soleil, retractable blinds provide shading when necessary (top and bottom); spiral ducting boosts the efficiency of the MVHR by reducing resistance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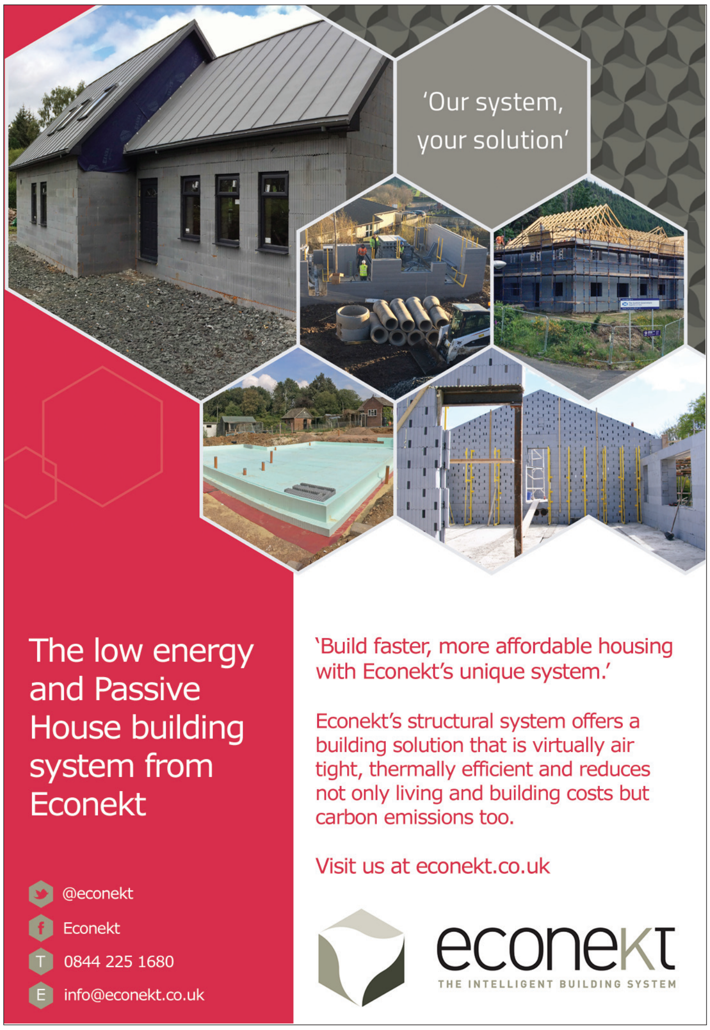
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continue to grow because it's a win-win-win situation. It wins on comfort, it wins on cost, it wins on sustainability. It wins in addressing fuel poverty, comfort and energy efficiency. And every time a passive house is built there is a mushrooming of expertise, understanding and knowledge.

All new housing should be built to the passive house standard, but if we are going to prioritise anything it should be social housing. It is really annoying that our government is promoting house building and a new crop of homes for first-time buyers, while at the same time talking about weakening energy efficiency standards. They're not future-proofing new houses. Energy is not going to come down in price in the foreseeable future.

Undoubtedly one of the biggest challenges is getting support for passive house from government, where it is up against various vested interests. It could be argued that big energy companies have a vested interest against passive house buildings because they don't want less energy being used. Politicians won't do anything about it unless there is a groundswell of people who want something to happen. It was good to be visited recently by Jonathan Reynolds, the shadow minister for energy and climate change, who seemed genuinely interested in passive house.

Meanwhile a local Green Party councillor Andrew Cooper, who has also visited Denby Dale, has been working on a policy to introduce passive house as a requirement on any land sold by our local authority Kirklees Council. Politicians need to pick up the baton and run with it. If we embrace passive house, society wins, the people who live in it win, the housing stock wins and the planet wins.

More information on the Denby Dale passive house, including technical films and a 40 page technical briefing, is at www.denbydalepassivhaus.co.uk

Monitoring reveals a comfortable, ultra low energy house

To better understand the performance of the Denby Dale passive house, the Centre for the Built Environment at Leeds Metropolitan University undertook a two year monitoring project on the house. Leeds Met researchers osbserved the construction, conducted air pressure tests, installed temperature, humidity and CO_2 monitors inside and outside the house, set up a small weather station, and interviewed both the occupants and the team from Green Building Store.

The research found that, even though daily average temperatures outside ranged from below -5C to above 20C, inside they generally stayed between 20C and 25C. Though there were a few incidents of overheating at first, the use of external blinds and purging the building of heat at night by opening the windows has helped to prevent this, along with the use of the MVHR summer bypass feature.

Regardless of conditions outside, relative humidity inside generally stayed between 40 and 60% inside the house. The clients have learned to deal with times of low humidity by turning down the MVHR flow rates, and even just using a wet towel. The gas boiler used 5095 kWH in its first calendar year, but just 3471 kWH in its second year, as the Tunstalls got to grips with the issues of the boiler cycling (see main article). Electricity demand was roughly 2,000 kWH per year, with the solar photovoltaic system producing around half this amount. The demand for space heating is estimated to be between 9 and 20 $kWh/m^2/yr$, according to the the research team's report.

PROJECT OVERVIEW:

Building type: 118 square metre detached two-storey masonry cavity-wall house

Location: Denby Dale, West Yorkshire

Completion date: April 2010

Budget: £141,000 (basic build costs)

Passive house certification: certified

Space heating demand (PHPP): 15 $kWh/m^2/year$

Heat load (PHPP): 10 W/m^2

Primary energy demand (PHPP): 87 $kWh/m^2/year$

Airtightness (at 50 Pascals): 0.33 ACH

Energy performance certificate (EPC): N/A

Measured energy consumption: 9 to 20.7 $kWh/m^2/yr$ (May 2011 to May 2012, estimate based on monitoring data)

Ground floor: 225mm Knauf Polyfoam insulation under 100mm reinforced concrete slab. Lightweight 100mm Celcon 7KN low thermal conductivity blockwork used for inner wall leaf below the slab to minimise thermal bridging through the 225m strip foundation. U-value: 0.104 W/m^2K

Walls: Masonry cavity walls (natural Yorkshire stone externally and dense concrete block internally) forming a 300mm cavity fully insulated with Knauf DriTherm Cavity Slab 32 mineral wool above the ground floor slab and polystyrene below. Walls finished internally with two coats of wet plaster for airtightness. Lightweight concrete blocks used for inner leaf below ground floor level to minimise thermal bridging from strip foundation (see 'ground floor'). Teplo Tie basalt resin cavity wall ties. U value: 0.113W/m^2K

Roof: Slates externally followed underneath by bobtail roof trusses wit 500mm fibreglass insulation, which meets the cavity wall insulation to prevent cold bridging. 18mm OSB board underneath for airtightness, sealed with pro clima tapes, with service cavity void underneath. U value: 0.096 W/m^2K

Windows: Ecopassiv timber triple-glazed windows with argon fill, low-e coatings and polyurethane-insulated thermal break in frame. Average overall U value: 0.8 W/m^2K

Heating system: Vaillant Eco Tec 612 (4.8 kW) gas boiler supplying one radiator in the living room and two towel rails. Duct heater installed in the supply side duct of the MVHR system. 2 x Schuco Premium Line solar thermal panels for domestic hot water. Primo twin coil ITSI 300 litre cylinder.

Ventilation: Paul Thermos 200 MVHR heat recovery ventilation system — Passive House Institute certified to have heat recovery rate of 92%.

Electricity: 1.2 kWp BP Solar photovoltaic system with Sunny Boy SB1100 inverter

Green materials: Bamboo flooring, natural paints

SELECTED PROJECT DETAILS
Clients: Geoff & Kate Tunstall
Architect: Derrie O'Sullivan Architects
Passive house design, main contractor, QS & MVHR: Green Building Store
Structural engineer: SGM Structural Design
Electrical contractor: John Gregson
Insulation supplier: Knauf Insulation
Solar thermal & solar PV: Eco Heat and Power
Airtightness products: Ecological Building Systems, via Green Building Store
Passive house certifier: Warm
External blinds: Dearnleys
Clay plaster: Womersley's
Thermal blocks: Celcon
Basalt wall ties: Ancon
Condensing boiler: Vaillant

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WARM & HEALTHY DEVON FLATS

that need no heating

This affordable housing scheme in Exeter not only embraces a suite of healthy and natural materials, but it has vindicated the local council's embrace of the passive house standard, with many of the units requiring no additional heating whatsoever.

Words: John Hearne

When Exeter City Council set out to build the Knights Place affordable housing passive development in 2010, it was a brave move, particularly for a local authority that hadn't actually built anything at all in twenty years. This was one of the earliest and largest passive house developments in the UK, constructed at a time when the industry in general wasn't especially familiar or enamoured with passive building.

The fact that it went on to win Eco Building of the Year Award in 2012 offered some vindication for the path the council had chosen, but of course the real test lay in how the development worked out in practice. With one eye on its future building plans, the council set out to monitor both the performance of the two buildings, and the engagement of their tenants. The results make for fascinating reading.

Emma Osmundsen, housing development manager with Exeter City Council, says that the decision to aim for passive in the first place stemmed in part from the fact that the new development was to be aimed at the over 55s. "We were acutely aware of fuel poverty issues and we were also very keen to build homes that promoted the health of our tenants. So we felt that the passive house standard was a good starting point."

In addition, the council was keen to set a high benchmark for new housing in the city. "This was very much about us being exemplar developers and demonstrating to the wider market that you can deliver very low energy homes in a cost-effective way."

The appointed architects, Gale & Snowden, had been specialising in low energy and fabric first development since the practice was established in 1992. Tomas Gartner, the lead architect on the project, explains while they hadn't specialised in passive, he was keenly aware of the movement, and as a native German, he had direct access to Passive House Institute documentation at a time when other designers were struggling over the language barrier.

The decision to go passive with Knights Place was not taken right away, however. At the outset, the project was specified as Code for Sustainable Homes level five. Not that there was any major conflict between the two standards, and Gartner had in fact incorporated passive principles in the design. In addition to a compact footprint, he had also included passive standard U-values and airtightness, minimal thermal bridging and a glazing strategy optimised for solar gains. Code five however required a big renewable element. The roofs, says Gartner, were "covered in PV" in the initial design.

It was at this point however that the government grants for solar PV installations ran out, dramatically changing the cost profile for the code level five approach. And so now, despite the fact that the foundations had already been laid, the design team changed tack and began to aim for passive. Up until this point, the plans hadn't even been run through the PHPP software.

But the fact that passive principles were already built-in meant that this wasn't the issue it might otherwise have been. And ultimately, despite a range of construction phase hiccups, the project — built with external insulated blockwork — was completed and the tenants moved in.

None of these tenants, naturally enough, had lived in a passive house before, so the city council put a lot of time and energy into what they call 'tenant training'.

"Every season," Emma Osmundsen explains, "we would visit all of the tenants and take them through what to expect in that season in terms of how best to use their home. Because some of the tenants are older, quite often we would see them on a one-to-one basis."

She says that to begin with, there were what she calls "psychological issues". There are no conventional heating systems at Knights Place — solar gains are simply supplemented with a heater battery in the MVHR (mechanical ventilation with heat recovery) ductwork. But perhaps because the tenants couldn't see fires or radiators, some reported that they were cold even when the sensors that the council had installed indicated a perfectly comfortable temperature.

As is frequently the case, the mechanical ventilation system also unsettled people at the beginning. A second, smaller development, Sivell Place – begun after Knights Place but finished before it – incorporated an MVHR system which, says Osmundsen, "had a control panel that was like something out of NASA." In order to make the system more user friendly in Knights Place, the controls were reduced to a simple on/off switch and a thermostat. This change, however, did not have the intended effect.

"What we found was at Sivell Place, nobody touched their MVHR. The controls were just too intimidating. People left it on the settings and everything worked perfectly. Then in Knights Place, where we simplified everything, people kept messing around with it because it was always too accessible to them."

After the tenants moved in, an in-depth evaluation study began, funded by the Technology Strategy Board (now called Innovate UK). The building performance evaluation report, published last summer after two years' worth of data and feedback had been collected, reported ongoing problems engaging with the MVHR. Tenants worried that because it was on all the time, it was using up energy, and they found it hard to grasp that the system was providing both heating and ventilation.

In the main however, tenant feedback was really positive. Astonishingly, in nine out of the 18 units, the occupants said they haven't used the heating. According to Tomas Gartner the units in the core of the building – the 1st floor and ground floor units, which are best protected - aren't using heating. The units on the perimeters are using a small amount of energy - but they're still generally within what you'd expect of passive houses.

The hard data collected by the remote monitoring system confirms a comfortable, healthy environment throughout the two year period. In one of the three flats monitored, the tenants never turned on their heating at all, this despite the fact that the monitoring period covered one of the coldest winters on record. The second monitored flat recorded a heating energy use of 11 kWh/m²a – well inside the 15 kWh/m²a passive house threshold. In one flat, the equivalent figure was 33 kWh/m²a, but this was explained by the fact that the tenants – who were smokers – kept their windows open throughout the winter.

"In nine out of the 18 units, the occupants said they haven't used the heating."

Nor were there any overheating issues in summer. Temperatures tended to creep up in one flat in particular, but this was explained by the fact the tenants didn't open windows at all because they were afraid of the cat getting out.

One aspect of the project not captured by the monitoring process was the fact it was built to building biology best practise standards. Building biology, Thomas Gartner explains, is a discipline which emerged in Germany in the sixties, in response to the health issues that arose as a result of the rapid construction methods employed after the war. Much of the focus has been on the potential of volatile organic compounds (VOCs) to offgas from building materials and damage the health of the occupants. Since that time, building biology has expanded to embrace a broad array of building issues, centred primarily on creating a healthy indoor environment.

Thomas Gartner again. "A lot of the passive house components that are on the market today are high performance components and ▶

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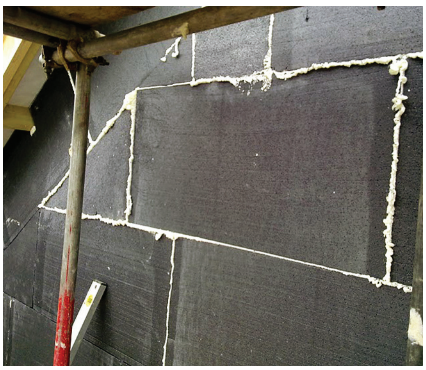

because passive house is pushing boundaries, some of these are highly questionable materials."

For him, building biology is primarily about risk management. "We look at substances that are on the World Health Organisation's list of carcinogenic substances and try to avoid these or any other substances that are potentially hazardous or may have a detrimental effect, then we try to avoid or minimise the use of these substances."

In Knights Place, natural and recycled materials were used wherever practical, as were locally sourced and low embodied energy materials. Low VOC organic paints, waxes and stains were specified throughout the build, and lead flashings were replaced by stainless steel and zinc. There are no carpets in the development, instead hard surfaces like ceramic tiles reduce the risk of dust mites. In addition, electrical wiring in bedrooms is radial, to lessen the exposure of tenants to electromagnetic fields.

Gartner says that taking measures like these does not have to be costly, so long as they are incorporated at the design stage.

"In all of our current buildings, we've brought down the cost of passive house considerably compared to our first passive houses. And at the same time, we are now constructing these houses to building biology compliant standards, and we are building them at no extra cost compared to a standard build of similar quality."

Emma Osmundsen says that some tenants have actually reported that they sleep more deeply at night. "We didn't tell them we had all these features," says Osmundsen, "but we had a couple of instances where people said 'Oh you know, since I moved here I sleep better'. We've also had a couple of people who had asthma and respiratory conditions who reported that they were having less frequent asthma attacks. Again, because there's no central heating or carpets, we're seeing much less dust.

"A lot of people say 'Oh you must be really proud and really delighted about Knights Place and I guess we are, but we've gone on to build quite a lot more passive house homes since then. For us, this is just the norm. We don't build to any other standard." ▶

SELECTED PROJECT DETAILS
Clients: Exeter City Council
Architect, landscape design M&E engineer & passive house consultant: Gale & Snowden
Main Contractor: ISG Ltd
PH certifier: Peel Passive House Consulting
Mineral wool insulation: Rockwool
EPS insulation (ground floor): Jablite
Windows: NorDan
External insulation system: Sto
Roof windows: Velux
Airtightness membranes & tapes: Tyvek, pro clima
I-beams: Finnjoist
Low thermal conductivity wall ties: Ancon
Low thermal conductivity blocks: Foamglas
Insulated structural blocks: Thermalite
Plaster (airtight layer): British Gypsum
MVHR: Zehnder

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(below) A thermal imaging survey highlights the low level of heat loss from the dwellings; (p51, anticlockwise from top) Finnjoist I-beam rafters; window airtightness detailing; the window sub-frame; walls are externally insulated with 250mm Neopor EPS; with gaps filled in; EPS insulation at window reveal; finished window detail

PROJECT OVERVIEW:

Building type: New build residential development. Two blocks comprising 18 one & two-bedroom flats.

Location: Exeter, Devon

Completed: 2010

Budget: £2.1m

Space heating demand (PHPP): 11 kWh/m²/a

Heat load (PHPP): 9 W/m²

Primary energy demand (PHPP): 115 kWh/m²/a (above figures are the same for both buildings when rounded)

Environmental assessment method: Code for Sustainable Homes level four

Energy performance certificate (EPC): A & B ratings

Measured energy consumption: 71 to 88 kWh/m²/yr (total energy consumption per unit)

Energy bills: £450-£650 a year per unit, including heating, all electricity use & standing charge

Airtightness (at 50 Pascals): 0.55 & 0.62 ACH

Walls: 6mm Sto Classic render externally, followed inside by 250mm Neopor EPS insulation, 215m dense concrete block, 15mm British Gypsum plaster (airtight layer). U-vale: 0.12 W/m²K

Roof: Clay roof tiles externally, followed underneath by battens/ counter battens, sarking, Finnjoist i-beams with 360mm Rockwool insulation, Tyvek vapour check & airtightness layer, service void with 50mm Rockwool insulation, plasterboard and skim. U-value: 0.09 W/m²K

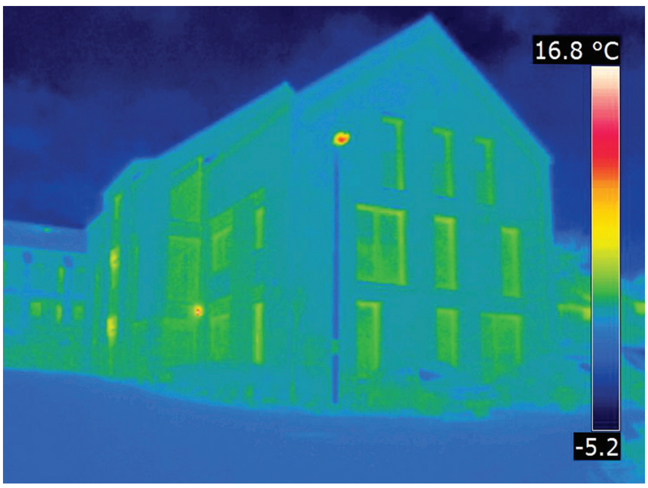
Floor: 200mm ground bearing concrete floor slab with 200mm Jablite EPS insulation and 60mm screed above. U-value: 0.10 W/m²K Windows & doors: NorDan NTech triple-glazed timber-framed windows & doors. Overall average U-value: 1.0 W/m²K

Roof windows: Velux GGU triple-glazed timber-aluminium composite roof window. Overall U value: < 1.0 W/m²K

Heating system: Electrical duct heater in MVHR supply ducts. Individual solar thermal systems to each flat providing domestic water.

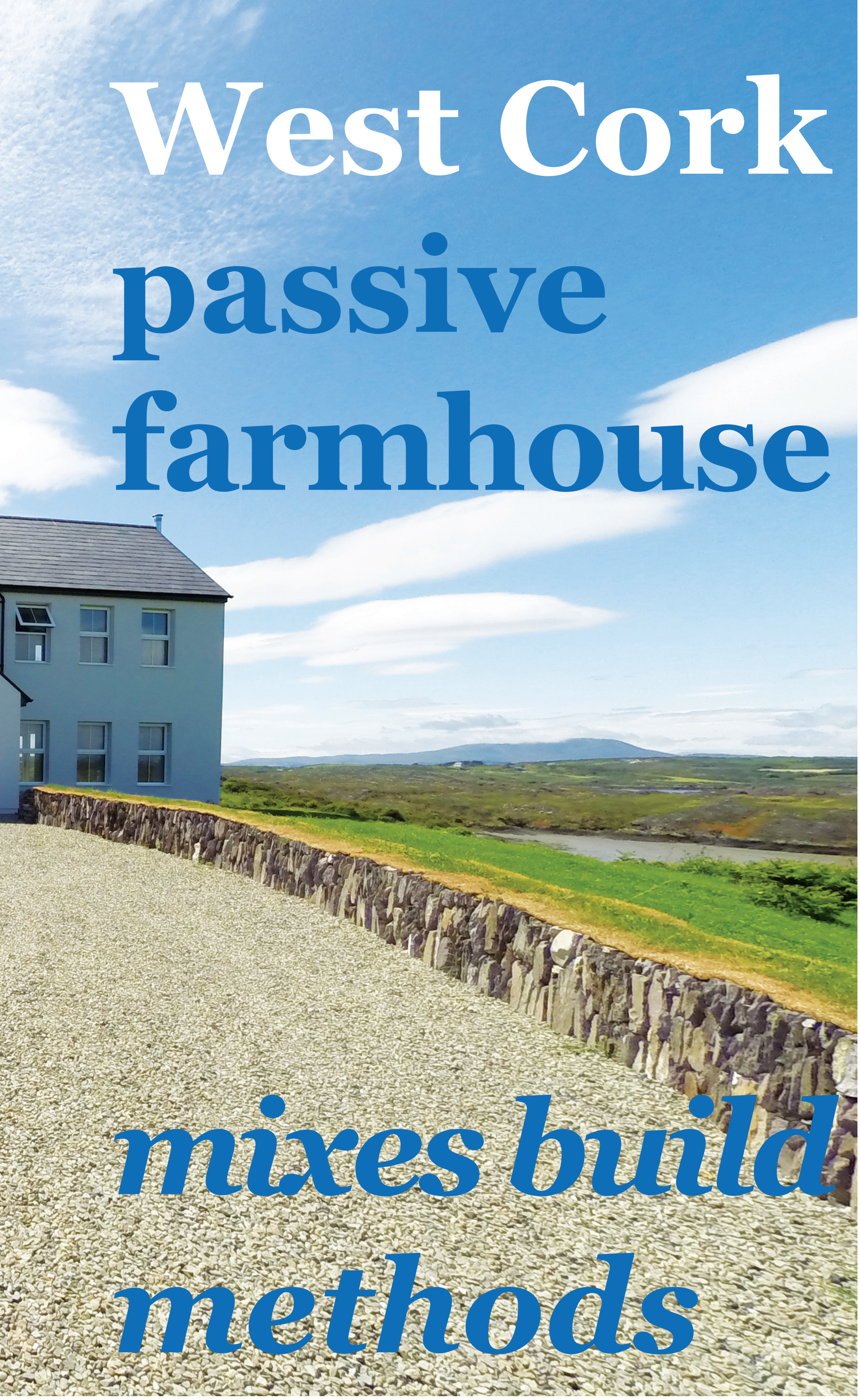
Ventilation: Zehnder Comfoair 200 MVHR in each flat, Passive House Institute certified heat recovery efficiency of 92%.

Green & healthy materials: All timber FSC certified, locally produced clay roofing tiles and ceramic floor & wall tiles, untreated timber cladding, highly permeable, natural or mineral paints throughout with minimal or no VOCs; no PVC or ABS used; permaculture landscaping; low EMF electrical installation and material specification; avoidance of dust mite habitats; permeable and hygroscopic finishes; energy efficient light fittings; water consumption less than 80 litres per person per day (CfSH Level 5/6 compliant)





West Cork passive farmhouse mixes build methods



This striking new-build passive house combines a traditional farmhouse form with ultra-low energy performance and a spectacular location – using two different forms of masonry construction.

Words: John Cradden

On a remote West Cork island not far from Baltimore sits a new tall, pale grey detached house and separate stone-clad studio that turns out to be a passive house, though it certainly doesn't look like one. Of course, passive house standards don't necessarily dictate what form a house should take, but most passive dwellings built in Ireland and the UK to date do seem to be modelled very much along contemporary lines.

"If you look at this building, you'd have to say no," agrees its architect, James Murphy O'Connor of Cork-based practice Boyd Barrett Murphy O'Connor. But he adds: "Using traditional techniques but being more rigorous about how you're applying them, you can achieve passive standards. They don't need to be contemporary buildings.

"With a little forethought at the various stages with regard to the importance of minimising thermal bridging and maintaining airtightness, a very efficient building can be achieved in a traditional building form."

Having said that, Murphy O'Connor is frank enough to admit that a traditional farmhouse wouldn't have been his first choice for a design that would meet passive house standards if he had been in his client's shoes. He believes a lower-key contemporary design would have been his more usual approach given the highly exposed location on the island of Reengaroga, which overlooks a small creek between the River Ilen and Baltimore Harbour.

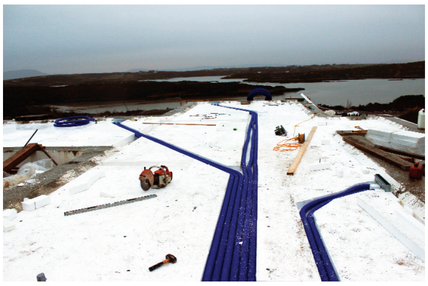
The clients, however, were insistent on a traditional form, and also that it be built on roughly the same footprint of the original buildings that it replaced — at least partly because it would have been very difficult or impossible to obtain new planning permission for a different footprint. Of course, he acknowledges that, as an architect, his personal opinion will not always be in line with his clients, and that he still has to decide how best to serve their needs.

"In this case, once the decision on the traditional form of the house was taken then it was a case of taking the views, the weather and other factors of the site into account to provide an optimum layout in the form of other farmhouses visible on the island."

At least one thing he and his clients agreed on at an early stage was to keep the studio close to, and at an angle to, the main house, thus "reducing the apparent scale of the main house and softening the impact of what is in fact quite a large house at an exposed location".

The homeowner works in the UK property industry and already came equipped with a robust knowledge of low-energy building design, as well as some foreknowledge of how new EU legislation may look at passive houses in the future.

"As this was a new build, he was fully on board from the outset with making this house as ▶



practically efficient as possible, and to do it in such a way that the result is controlled and calculated to work," said Murphy O'Connor.

"Passive house standards offer the levels of comfort and energy efficiency to make this happen. It does not leave room for doubt as the physics of the building are calculated precisely." This included obtaining local climate information so that the build suited its particular south-west coast environment rather than the generic data in the PHPP.

"The standard data sets in PHPP for Ireland are based on either Birr in the midlands or Dublin," said Murphy O'Connor. "West Cork, anecdotally, has a much milder year-round climate and the localised data supports this. This in turn allows you model the building physics more precisely say, for example, reducing insulation requirements and hence costs."

A major contributor towards ensuring that the house had no thermal breaks was the use of a Kingspan Aerobord Supergrund foundation system, which completely isolates the house from the ground. To allow for added loads, Foamglas Perinsul blocks were used to transfer isolated loads to the ground in particular locations, thus minimising the thermal transfer. The main walls are made with 225mm single leaf blocks that were rendered before the application of Sto external insulation and finish. The roof is of traditional construction but with airtight membranes.

A similar isolated foundation system was used for the studio building, but the studio's walls are of wide 300mm cavity wall construction with a full-fill pumped bead insulation, so that they could support a natural stone cladding exterior. Low thermal transfer extruded basalt wall ties were used to minimise thermal transfer across the cavity.

Visually, the contrast between the smooth rendering of the main house and the stone cladding of the studio creates a nice effect, with both buildings enhancing each other. The same stone has been used in the extensive landscaping around the house.

In both buildings, the windows are set into the insulation layer to prevent thermal bridging. Holes for services were kept to a minimum and airtight tapes employed at window and floor junctions, with the result that the house meets the exacting airtightness target for passive houses.

Other than a room-sealed Chesney Milan 4 Passive wood burning stove, the house is heated by a Nilan Compact P system. The unit, which combines an exhaust air-to-water heat pump with heat recovery ventilation, supplies underfloor heating in the farmhouse and adjacent studio – via heavily insulated pipes between the buildings – and also provides domestic hot water. The studio's ventilation strategy uses an Aereco demand controlled mechanical extract ventilation system instead of MVHR.

The ductwork runs for the MVHR system is divided between the ground floor, first floor and vaulted ceiling.

"The ductwork is set into the top 100mm layer of the 300mm floor insulation, keeping the gaps in the insulation to a minimum, and cutting it in quite tightly," said Murphy O'Connor. "All delivery air is to floor boxes and the exhaust air is at high level."

As well as the traditional style and form, the other notable thing about this build is that the cost was on a par with a conventional build. "The cost of this build is no more than the cost would have been if we were to have used basic but regulatory compliant construction techniques and achieved a BER A2 rating," said Murphy O'Connor.

Two factors helped. The first was the very simple traditional form of both buildings and the use of traditional building techniques, albeit in a more rigorous manner. The second — and possibly more important – factor to keeping the cost down was the quality work of the contractor, David Evans, with whom Murphy O'Connor has worked with on builds in West Cork over 15 years. As well as being Murphy O'Connor's first passive house build, it was also a first for Evans, who was keen to be involved.

"He was very eager, and hence getting such a good price, he priced the job well because he wanted to do it. He was also eager to learn about low-energy building," said Murphy O'Connor.

So the challenge of the build was as much to do with the design as the fact that it was a new experience for both of them, particularly in the need to focus on the small details that are so crucial with passive house builds. "Without that prior experience, you don't know how critical they are. So we probably over-focused on certain elements of it, particularly in relation to the airtightness."

Much of it was simply about thinking ahead, but it helped that Evans is "such a conscientious builder", said Murphy O'Connor, adding that he was willing to learn, get the right advice, ask the right questions about airtightness and even got reps from the various companies down to site if necessary to demonstrate the use of products like airtight tapes. The result was that he returned a successful airtightness pressure test of 0.5 air changes per hour at 50 Pascals at the first attempt.

It sounds like the pair could be even more cost-competitive with a similar build in the near future. "Because we were taking a belt and braces approach to the build, in hindsight there were probably areas where I could possibly have saved a little bit of money by using different methods of construction."

Although this is the first house Murphy O'Connor has completed that he hopes to have certified by the Passive House Institute, others are now in the pipeline, including another in Cork, one in Co Kerry and an apartment building in Cork City. "People are becoming more aware of what real energy efficiency in construction means, and that is certainly not just applying the minimum standards to get you over the line in terms of regulatory compliance."

However, he says it's a constant battle to persuade others that a Building Energy Rating score of A3, as calculated by the Deap software, is not the be-all and end-all of energy efficiency. "The reality is that doesn't guarantee the comfort levels that a passive house does, and to explain to people why that is, it boils down to the fact that [Deap] calculations are not rigorous enough, they're too general.

"In both buildings, the windows are set into the insulation layer to prevent thermal bridging."

"With a passive house, the calculations are really specifically for that building, for that location. All of the building's physics are taken into account to a far greater degree than using your standard Deap calculations."

Which leads us to what some might rigidly interpret as the building's one failing: the fact that the renewable energy supplied by the heat pump and biomass stove in the building doesn't satisfy the renewables target in the technical guidance document to Part L of the Building Regulations. The Deap calculations came out well short of the target of 10 kWh/m²/yr.

However Murphy O'Connor is philosophical. He argues that even though it doesn't meet the advised target in the TGD, it meets the requirements of the statutory regulation, which says that a "reasonable proportion" of a building's energy demand must come from renewables, given that renewable energy systems meet the entire heating and hot water demand, albeit with the heat pump using grid electricity to generate renewable heat. Oddly, part of the problem is that the building was too efficient – Deap credits it with a 70.6% energy reduction compared to 2005 regs, when a 60% reduction is demanded by TGD L. Had it been less energy efficient, the renewable energy systems would have had a higher demand to meet, and would have scored higher.

"If you have a low-performing building you need a higher level of renewables to show a relative energy performance, but if you have a building that doesn't need much energy input, then you don't need the renewables — so you don't meet your target. So you're actually complying with the legislation but you're not conforming with the Deap calculator."

Achieving the more rigorous passive house standard, he says, "is more onerous on the designer and the contractor but results in a better building".

SELECTED PROJECT DETAILS
Client: Gregory & Amanda Besterman
Architect & passive house designer: Boyd Barrett Murphy O'Connor
Contractor: David Evans Construction & Joinery Ltd
Mechanical contractor, heat pump & MVHR system: Nilan Ireland
Electrical contractor: Don MacCarthy Electrical
Energy assessor: National Energy Assessors
External insulation: Sto
Airtightness tapes and membranes: Siga
Insulated foundation system & rigid insulation: Kingspan
Mineral wool insulation: Isover
Thermal blocks: Foamglas, via TIDL
Windows: Munster Joinery
Wood burning stove: Chesney's, via The Woodburning Centre
Twin wall flue: Oriel Flues Ltd
DCMEV: Aereco

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PROJECT OVERVIEW:

Building type: 266 sqm block-built detached house with external insulation, plus 82 sqm detached studio, block-built with wide cavity construction

Location: Reengaroga, West Cork

Completion date: June 2015

Budget: €440,000

Passive house certification: main house pre-submission; studio fabric built to passive standards but not seeking certification

Space heating demand (PHPP): 12 kWh/m²/yr

Heat load (PHPP): 9 W/m²

Primary energy demand (PHPP): Not yet available

Airtightness (at 50 pascals): 0.5 ACH at first fix, awaiting re-testing.

Energy performance coefficient (EPC): 0.294
Carbon performance coefficient (CPC): 0.296

BER: A2 (43.42 kWh/m²/yr)

Thermal bridging: Fully isolated Supergrund slab system (Foamglas Perinsul blocks used in isolated locations for load bearing), external insulation meeting roof insulation to create a continuous thermal wrap, passive-certified windows in insulation layer.

Ground floor: Supergrund insulation foundation system with 300mm of extruded polystyrene. Nilair MVHR supply ductwork cut in tight runs into top 100mm of insulation. DPM stepping over the ring beam, then mesh and 100mm structural screed containing underfloor heating pipework. U-value: 0.114 W/m²K (same as for studio building)

Walls (main house): Internal plaster, 215mm block, cementitious render and StoTherm Classic K, including adhesive fixing, 250mm StoTherm EPS, cement-free reinforcing render with glass fibre mesh embedded into reinforcing coat & acrylic render finish. U-Value 0.132 W/m²K

Walls (studio building): internal plaster, 100mm blockwork, 300mm blown bead insulation, 100mm blockwork followed outside by 200mm natural stone externally. U-Value 0.113 W/m²k

Roof: 300mm Isover Comfort 32 quilt insulation over and between rafters, Siga Majpell vapour control membrane & airtightness membrane with Kingspan K18 insulated plasterboard underneath. (same as for studio building)

Windows: Munster Joinery passive-certified Passiv uPVC triple-glazed windows. Overall U-value: 0.78 W/m²K Triple-glazed Munster Joinery uPVC oculus and fan light windows. U-value 0.99 W/m²K.

Heating system: Nilan Compact P exhaust air-to-water heat pump with heat recovery ventilation, and supplying underfloor heating in hall, kitchen and bathrooms. Passive House Institute certified heat recovery efficiency of 77%. Plus Chesney Milan 4 Passive airtight wood burning stove with external air supply, and twin wall flue.

Ventilation: Nilan Compact P for the farm house, as per above, and an Aereco DCMEV system for the studio, with BXV extract units in the kitchenette and bathroom.

(left) The house features a Chesney Milan 4 Passive room-sealed wood burning stove; (opposite page, from top) the studio's insulated foundations and underfloor heating pipework; MVHR supply ductwork installed into top 100mm of floor insulation; the studio's walls are of 300mm cavity wall construction with a full-fill pumped bead insulation, so that they could support a natural stone cladding exterior; the MVHR ductwork is divided between the ground floor, first floor and vaulted ceiling; the Siga Majpell vapour control membrane protects the building against excessive moisture penetration; the walls of the main house are externally insulated with 250mm StoTherm EPS with adhesive fixing

Ecological PASSIVE HOUSE *built on tight budget*

Despite some setbacks, this passive house in Roscommon managed to meet the passive house standard for fairly standard costs — all while emphasising natural materials like untreated timber, cellulose and sheep's wool.

Words: John Hearne

Art Timmins had been thinking about changing his living space for years, and had explored a range of refurbishment possibilities before deciding to start again with a new-build passive house. "We were living on the side of a mountain in a 150-year old three-room cottage with an extension," he says, "I'm after going from one extreme to the other."

He moved into his new passive house in March, so he hasn't yet had a full heating season to compare old with new. The old cottage, however, was swallowing €3,500 worth of heating oil every year, so at the very least, the savings should be dramatic. Art had known Roman Szypura of Clíoma House from an insulation project Roman had carried out for Art years before. Because that experience had been so positive, Art approached Roman when he needed to build a new house from scratch.

"He had a really tight budget," Roman explains, "so he got into contact with me and asked if it would be possible to build a passive house for €200,000. This was a 218 square metre house – so 200K is a tight budget. But I said it could be done."

Keeping within that budget then became the central challenge of the build. At first glance, the site that Art had chosen appeared to be almost perfect, with a full, unobstructed southern aspect at the back. Even better, the architect Art used to provide planning drawings had delivered a layout and a glazing plan that worked perfectly, even though permission had been sought before the decision to go passive.

"The house is basically rectangular with the

The same goes for cold bridges. "We chose a build-up that is relatively simple," says Roman, "and that naturally has no cold bridges. To be honest I wasn't scratching my head for even ten minutes about it."

By contrast, it was the conventional stuff that ended up causing problems. In addition to the need to raise the site, a retaining wall was required around the perimeter. There were also headaches in relation to connecting the house with mains services and opening up the site to the road, together with a range of scheduling issues that had nothing to do with the passive spec.

"Meeting the passive house standard wasn't a challenge at all," Roman explains. "That was almost the smallest part. The big problems were the things I wasn't really used to... There was a lot of frustration around lining up contractors, around the wrong materials being delivered or else not being delivered on time."

Similarly, the team was able to deliver passive house materials and techniques within the budget, but it was the ancillary issues that drove costs higher — despite the fact that Roman went to great lengths to ensure the quality of those materials.

long side facing north to the road and south to the back, so it's perfectly lined up," says Roman. "The main living areas and most of the glazing was on the south, with bedroom, bathroom and utility to the north." Because the orientation and layout were so good, and the house itself had a simple, compact footprint, going from conventional to passive design was relatively straightforward.

That, however, was where the good news ended. It turned out that the site needed extensive groundworks, and had to be raised by nearly three feet. This unforeseen eventuality blew a hole in the budget. As the project progressed, an unusual pattern began to emerge. Because Roman had so much experience at passive building, the typical passive house challenges hardly cost him a second thought.

Take airtightness. The house achieved a rating of 0.23 ACH at 50 Pa, an exceptional result that exceeds the passive house standard of 0.6 ACH by a very generous margin. Roman's main expertise is airtightness, and during this stage of the project, he used his own team of installers, all of whom were passive house certified tradespeople. "My main guy Gary Waters has been with me now for four years and is absolutely second to none as an airtightness installer," Roman says. "He's as good as me, only faster. That's why airtightness wasn't really a challenge."

> "The old cottage was swallowing €3,500 of heating oil every year, so the savings should be dramatic."

"We were eager to use as few glues and toxins as possible," says Roman, "and create a healthy living environment by using as much natural timber as possible."

Roman is keen to emphasise one innovation which he and his team implemented on the build. The initial plan had included a truss roof, but shortly before work began, he realised that this approach would require huge amounts of additional airtightness work – upwards of 900 individual seals.

"Instead, we invented a new way of building a traditional cut roof that allows you to preinstall the airtightness membrane around the ceiling joists." It's a solution, Roman believes, that would make it much easier for builders to achieve passive airtightness results with traditional style roofs. "It's one of the things I was most excited about on the build. We found a really smart solution there."

In the end the house itself ended up costing about €215,000, excluding the groundworks and site works. Still, this put the price of the house itself at about €91 per square foot, ▸

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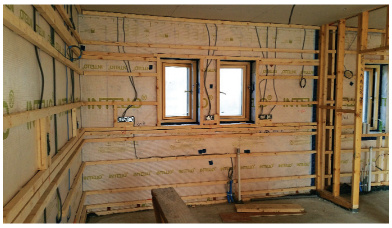

well within conventional boundaries.

Art Timmins is very positive about the whole experience. He says when you're looking for someone to build your house, they have to fulfil two – and only two — conditions. "The key really is that you need someone who knows what they're doing and you need to be able to trust them. That was Roman. He knew what he was about and he was totally trustworthy."

SELECTED PROJECT DETAILS
Client: Art Timmins
Architectural design, planning: O'Rourke Design & Planning
Passive house design, project management, main contractor & airtightness: Clíoma House
Timber frame: Clíoma House/RC Building Consultancy
MVHR design: Digren
Civil & structural engineering: O'Rourke Design & Planning/CST Group
PHPP & passive house certification: Target Zero
BER: Energy Rating & Planning Services
MVHR system design, supply & installation: A+ Ventilation Supplies
Plumbing: Brian McCann Plumbing & Heating Contractor
Electrical contractor: Aidan Hackett Electrical
Airtightness testing: ABuild
Natural insulation & airtightness products: Ecological Building Systems
EPS insulation: Kingspan Aerobord
Windows & entrance doors: Munster Joinery
Roof windows: Roto Roof & Solar Technology
Screeds: McLaughlin Concrete Flooring
Heating system supplier: Joe Simon Building Supplies
Roofing: J Long & Son Ltd

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(clockwise from top) Extenders on structural rafters to enable installation of 50mm EPS thermal breaks; the roof's timber sheeting layer; an airtightness strip detail in the attic with EPS thermal break installed on rafter; installed Roto Designo roof windows; airtightness detailing including gromit around ductwork; a battened service cavity inside the airtight layer; (p59, from top) raft foundation with Quinn Lite blocks; airtightness membrane preinstalled around the webbed ceiling joists; timber frame being erected; walls are filled with 330mm Dämmstatt cellulose insulation

PROJECT OVERVIEW:

Building type: 219 square metre detached timber frame dwelling

Location: Boyle, Co Roscommon

Completion date: March, 2015 (excluding site-works & landscaping)

Final cost: €215,000 approximately (excluding site-works & landscaping)

Passive house certification: pre-submission

Space heating demand (PHPP): 12 kWh/m^2/yr (based on preliminary airtightness results)

Heat load (PHPP): 7 W/m^2 (based on preliminary airtightness results)

Primary energy demand (PHPP): 83 kWh/m^2/yr

Airtightness: 0.23 ACH at 50 Pa

Energy performance coefficient (EPC): 0.313

Carbon performance coefficient (CPC): 0.346

BER: A2 (49.52 kWh/m^2/yr)

Thermal bridging: Raft foundation with first three course of Quinn Lite aerated concrete blocks, timber frame / Larsen truss walls and roof structure, timber / aluclad windows located in accordance with PH recommended window details, insulated reveals and cills. Y-value (based on ACDs and numerical simulations): 0.08 W/mK

Ground floor: 75mm screed on 260mm EPS100, on Monarflex RMB350 radon membrane, on 150mm reinforced concrete raft to engineer's specification. U-Value: 0.13W/m^2K

First floor (inside the thermal envelope): Laminate floor on soundproofing layer, on two layers of 12mm plywood, on 405mm top hung Easi-Joists, (filled with 405mm Dämmstatt cellulose insulation), on pro clima WA membrane, on 35/48mm counter batten, on 12.5mm gypsum board. U-Value: 0.093 W/m^2K

Walls: 20mm Nap plaster finish, on 100mm blockwork rain screen, on 50mm ventilated cavity, on pro clima Solitex Fronta Humida wall membrane, on 125 x 25mm untreated diagonal racking, on timber frame / larsen truss wall constructed with untreated 89 x 38mm outer non-loadbearing stud, with untreated 139 x 38mm internal loadbearing stud both at 600 Crs, with 12mm 300 x 375mm gusset plates at 1200mm Crs (filled with 330mm Dämmstatt cellulose insulation), on untreated 125 x 25mm untreated diagonal racking, on pro clima Intello Plus airtightness membrane, on untreated 50 x 50mm battens at 400 Crs forming service cavity with 50mm Thermafleece sheep wool batts, on 12.5mm Gypsum plasterboard. U-value: 0.10 W/m^2K.

Roof: Natural slate on 44 x 38mm slating batten, on 44 x 38mm ventilation battens (running same direction as the rafter on top of the rafter), on pro clima Solitex Plus breathable membrane with pro clima Naidec nail sealing tape, on 22mm natural timber sheeting, on a Larsen truss roof / rafter system made up of 125 x 44mm rafters on 50mm EPS rigid insulation, on 225 x 44mm rafters with 12mm 300 x 375mm gusset plates at 1200mm Crs. (filled with 400mm Dämmstatt cellulose), on pro clima Intello Plus airtightness membrane, on untreated 50 x 50mm battens at 400 Crs forming service cavity with 50mm Thermafleece sheepwool batts, on 12.5mm Gypsum plasterboard. U-value: 0.093 W/m^2K.

Ceiling / roof (to cold attic): 530mm Dämmstatt cellulose, on 150 mm collar ties, on pro clima Intello Plus airtightness membrane, on 48/48mm counter batten, on 12.5mm gypsum board. U-value: 0.075W/mK

Windows: Munster Joinery passive house certified EcoClad timber-aluclad triple-glazed windows with argon filling and a U-value of 0.7 W/m^2K for the glazing, and overall U-values of between 0.99 W/m^2K and 0.79 W/m^2K installed (including frames).

Roof windows: Roto Designo roof windows with R8 BlueTec Plus glazing 9P (compliant with passive house) with prefitted insulation collar against heat loss, and vapour barrier for optimal airtightness. Overall U-value: 0.84 W/m^2K

Heating system: 92% efficient Grant Vortex condensing oil boiler supplying three radiators and 300 litre two-coil Joule stainless steel cylinder, plus 40-tube Joule Acapella solar thermal array.

Ventilation: Zehnder ComfoAir 550 MVHR system, Passive House Institute certified to have heat recovery rate of 84%, EN 308 certified efficiency of 92.7%.

Green materials: cellulose insulation, sheep wool insulation, untreated timbers.

(from top right) The roof begins to take shape; Thermafleece insulation used at window reveals; shown here is the 100mm blockwork, a 50mm ventilated cavity, and a Pro Clima Solitex Fronta Humida wall membrane; (below) the house is rendered externally with a Nap plaster finish

MANCHESTER SOCIAL HOUSING gets passive regeneration

The upgrade of two social housing blocks in Manchester to the Enerphit standard demonstrates how deep energy retrofit can play a part in turning old, run-down estates into vibrant, comfortable, low energy communities.

Words: Lenny Antonelli

Recently nominated for a UK Passivhaus Award, the deep energy retrofit of Erneley Close in Longsight, Manchester represents one of the most exciting recent regeneration projects in the UK.

It's the latest in a long string of upgrades for Eastlands Homes, which was established in 2003 after taking over 3000 properties from Manchester City Council. The group set out on a five year programme to renovate those properties, bringing them up to the Decent Homes standard and beyond. In 2009, Eastlands took over a further 5300 properties, including Erneley Close, and started working to improve these too.

This time Eastlands was keen to push some of the properties further in terms of quality, comfort and energy efficiency. "We had just gone through the financial crash in 2008, and austerity was on its way," says David Williams, a director at Eastlands. The organisation could see that its tenants might struggle financially, and that fuel poverty was rising.

"We said, what about trying something we could really learn from, and that would actually make a big difference to our customers?" Williams had heard about passive house, but mostly in the context of mainland Europe — and mostly in relation to new build projects.

Eastlands started looking at the profile of its housing stock to see which properties were in most urgent need of regeneration. "I remember arriving at Erneley Close. I remember thinking — these properties don't look good, from the outside, aesthetically. They just looked down and in a poor state," he says.

Photos: Tim Bradley Photography

Erneley Close consists of 32 maisonettes — one block of 20 and one block of 12. It was an obvious candidate for regeneration and a deep energy retrofit. The buildings were in poor repair and physically isolated from the surrounding neighbourhoods. Inside, the maisonettes suffered from condensation and black mould, and had rather unpleasant internal bin chutes.

Eastlands began talking to R-Gen Developments, a private development company with experience in both sustainable building and regeneration. Williams says: "That's where it hatched from really, and then we started looking at it in a bit more detail. And it went from there, we got some designs, and with the backing of our board embarked on the project."

R-gen are particularly keen to espouse the benefits of the passive house approach (in terms of fuel poverty, carbon, and health benefits) to housing associations, particularly over other green building targets such as the Code for Sustainable Homes. "Because the passive house approach is a fabric first approach," says Phil Summers, director of R-gen.

At Erneley Close, Summers saw passive house as "a means of engaging with a very tight community and as a means of regenerating a very poor [building] stock and a very poor area." He adds: "It was about creating a new housing identity."

R-gen brought on board Manchester-based architectural practice 2e Architects, who have experience in low energy building and had also completed the regeneration of 11 tower blocks. The firm had never done a passive house, but was eager to demonstrate that the standard is a viable option for projects like this.

And coming from Germany, architect Kim Ebling was long familiar with the passive house concept. "It was quite nice to hear that England was coming around to this type of thinking," she says.

The team also hired experienced passive house designer Eric Parks as consultant. Parks previously told Passive House Plus (in issue eight) that Erneley Close was "amazingly cold and uncomfortable" and the maisonettes "managed to be both stuffy and draughty."

The team looked at the possibility of knocking down and rebuilding, but decided against. This would have meant displacing tenants, which Eastlands didn't want to do, and they also wouldn't have been able to rebuild as many units on the site.

They decided to retrofit and aim for the Enerphit standard, but the overall goal was about much more than energy efficiency. "We could also create a nice environment outside," David Williams says. "Plus we wanted to create a community spirit, and encourage people to change the way they live, for example promoting recycling and a new system of waste removal." There was extensive community consultation before the project went out for planning permission, to ask tenants what they wanted from the regeneration and to discuss ideas — vital for getting tenants to buy into the project.

Erneley Close was originally of cavity wall construction. The original plan was to strip off the outer leaf of brickwork and concrete tiles, and then parge and externally insulate the inner leaf. But when contractor Caseys opened up the walls, they found the inner leaf to be a mishmash of blockwork, brick and even some timber. Eastlands was worried about its structurally safety, and made the decision to remove the inner walls entirely. The team had to change tack and completely rejig the design, opting instead to re-build the main elevations with timber panels, pre-fitted with mineral wool insulation and pro clima airtightness tapes. This, along with the decision to completely remove the existing boilers from each flat, meant that the tenants did have to move out temporarily.

The gable walls were deemed safe though, so were given cavity wall insulation and fitted externally with JJI joists that were insulated variously with rigid and semi-rigid insulation. The unheated stairwells were insulated in the same manner. Outside, the architects specified a striking Rockpanel Chameleon rain screen cladding that completely transformed the look of the development. The cladding's colour changes depending on what angle it is viewed from, and how the sunlight hits it.

"We wanted to make it appealing," says Kim Ebling. "We wanted to highlight how beautiful it can look."

The building's walkways and vertical fins were externally insulated with fibreglass mats, helping to cut down the almost endless thermal bridging of the original structures. But even with the insulation, these structures are still responsible for about one third of heat loss after the retrofit. ▶

(Top left) New timber infill panels being installed; (top right) 300mm timber I-beams & Ecocontract windows; (above) rigid insulation installed in the I-beam webs; drainpipes installed between the SolitexFronta membranes and (below left) Rockpanel cladding and Gebrik cladding; (opposite page) new community garden at Erneley Close; Compacfoam 400 at door threshold; a temporary roof scaffold was built for the removal of the exisiting & installation of a new insulated flat roof system; the development prior to its regeneration

The original roof trusses were removed and new flat roofs — insulated with high performance rigid insulations — laid on top of the existing roof decks. The ground floors were fitted with 30mm vacuum insulated panels — high performance and low in thickness so as not to restrict height under doorways. The double-glazed uPVC windows were removed throughout and replaced with EcoContract triple-glazed timber windows and doors from Green Building Store, who supplied the windows in pre-prepared insulated plywood boxes, to make installation easier and to help reduce thermal bridging around the window junctions.

The individual gas boilers used to service each maisonette were replaced with two high efficiency communal gas boilers in a central

“It’s an estate people are aspiring to live in, whereas before it was one people were aspiring to leave.”

service space. These are connected via flow-and-return pipes to each unit, providing heating and hot water. Zehnder ComfoAir 160 MVHR units now provide fresh air to each of the maisonettes. These compact MVHR units were installed in bathrooms, and Green Building Store, who supplied the systems, came to the site and explained exactly to the tenants how the systems work.

Ultimately, all the hard work paid off — in terms of one measure of quality, airtightness, both blocks came in around 0.8 air changes per hour, well inside the Enerphit standard of 1.0.

Outside of energy efficiency, dealing with waste on site was one of the major goals of the project. Now there are new communal recycling areas outside each block, which mean tenants have to do a bit more work to dispose of their rubbish, but the waste chutes are gone and conditions inside much nicer. There are new secure parking facilities, new landscaping and a new community garden.

It may seem like a trite question, but with the regeneration complete and the tenants moved back in, how does the new differ from the old? “When you look at them now you say wow, what a difference,” David Williams says. “They do look amazing, as well as providing homes that have much reduced energy costs.”

Phil Summers says the tenants have all bought into the refit in a big way. “If you go down to the estate now it’s completely transformed. It’s an estate people are aspiring to live in, whereas before it was one people were aspiring to leave.”

Eastlands is now monitoring energy bills closely to measure the difference the upgrade has made, and paying close attention to feedback from tenants. “I know some of the initial results have been very encouraging,” David

Williams says. "Certainly there's been really positive feedback from the customers on how little they're having to use their [heating] systems." He adds that a lot of work has gone into teaching tenants how to 'use' the buildings.

Meanwhile R-gen's Phil Summers says the external works have been fundamental to the regeneration of Erneley Close. "The more you can put in the landscaping to soften the site, the more you can get people involved in the design, the more use you get out of it," he says. "And I think it's worked."

SELECTED PROJECT DETAILS
Clients: Eastlands Homes (part of One Manchester group)
Architects: 2e Architects
Project manager: R-gen
Passive house consultant: Eric Parks
Airtightness test: Aldas
Main contractor: Casey
M&E consultant: Alan Clarke
Structural engineer: Marston Grundy
Passive house certifier: Warm
Windows & doors, airtightness products & MVHR: Green Building Store
Thermal breaks: Compacfoam
Cladding: Rockpanel
Mineral wool insulation: Rockwool & Knauf
Rigid insulation: Celotex, Kingspan, Recticel & Xtratherm
Vacuum insulated panels: Vacutherm
OSB: Norbord
Roofing: Triflex
Condensing boilers: Worcester Bosch

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PROJECT OVERVIEW:

Building type: Mid 20th century solid and cavity wall construction, consisting of 32 maisonettes in blocks of 20 and 12, typical size 60 sqm.

Location: Longsight, Manchester

Passive house certification: 12 unit block Enerphit certified, 20 unit block Enerphit certification pending

Space heating demand
Before: 300+ kWh/m^2/yr
After: 23 kWh/m^2/yr (for both blocks)

Heat load
Before: 123 W/m^2
After: 12 W/m^2 (for both blocks)

Primary energy demand (PHPP)
Before: Not known
After: 115-120 kWh/m^2/yr

Airtightness (at 50 Pascals)
Before: Not tested – assumed to be at least 10 ACH.
After: 0.8 ACH (for both blocks)

Walls
Before: Brick or hanging tile outer leaf with empty 50-70mm cavity and inner leaf of concrete block or brick. U-value: 2.0 W/m^{2}K and greater
After (new timber infill panel walls): Rockpanel Chameleon board externally, on ventilation void / battens, on pro clima Solitex breather membrane, on 9mm OSB, on 300mm timber I-beam wall – fully filled with 300mm low-conductivity (k=0.033 W/mK) mineral wool insulation and webs filled with rigid insulation (k=0.023 W/mK). Internally lined with pro clima DA membrane on 18mm OSB on 100mm stud wall – fully filled with mineral wool (k=0.038 W/mK) sheathed with 9mm OSB and finished in plasterboard and skim. U-value: 0.097 W/m^{2}K
Gable walls (after): Cavity wall newly insulated, and external brickwork followed outside by parge coat, 300mm rigid high performance insulations (combination of phenolic & mineral wool batts) within void created by vertical JJI joist. 9.5mm OSB board fixed to face of JJI joists with 100mm gap then Rockpanel Chameleon rain screen cladding externally. U-value: 0.12 W/m^{2}K
Sub-floor: externally insulated with 250mm of Styrozone XPS insulation, fitted to 100mm thermal blocks. Brick clad wall sections: Gebrik brick slips on ply battened to Solitex breather membrane. Wall build-ups then as per above.

Roof
Before: Concrete tiled over-roof on timber trusses covering original, uninsulated felt flat roof. U-value: 2.0 W/m^{2}K
After: Trussed over-roof removed and new insulated flat roof laid on top of existing roof deck: 18mm OSB decking laid on existing flat roof surface, vapour / air tightness barrier applied over deck, rigid insulation (k=0.023 W/mK) insulation applied in varying thicknesses (from 200-300mm) and finished on top with Triflex liquid applied roofing system. U-value: 0.08 W/m^{2}K
Ground floor build up: Concrete followed above by 50mm screed, then 30mm Vacupor NT vacuum sealed insulated panels (VIPs), then 22mm T&G flooring. U-value: 0.21 W/m^{2}K

Windows & doors
Before: Double-glazed, uPVC windows and doors. Overall approximate U-value: 2.1 W/m^{2}K
New triple-glazed windows: EcoContract doors and windows with argon fill and warm edge spaces. Overall U-value of 0.85 W/m^{2}K (windows) and 0.95 W/m^{2}K (doors). Compacfoam 400 used at door thresholds to reduce thermal bridging.

Heating system
Before: Individual condensing gas boilers & radiators to each flat.
After: Two communal boilers installed in central service space above communal stairs in each block. To 12 block maisonettes: Two x Worcester Bosch GB162 65kW boilers. To 20 block maisonettes: Two x Worcester Bosch GB162 80kW boilers. The two boilers in each block are linked via flow and return pipes to heating interchange units in each maisonette that contain two heat exchangers: one for the heating circuit; one for domestic hot water.

Ventilation
Before: Extract fans to Kitchens and Bathrooms.
After: Zehnder ComfoAir 160 whole house heat recovery ventilation unit and system installed to each flat. Passive House Institute certified unit. Typical heat recovery efficiency of 86% (as calculated in PHPP for multiple ventilation units)

Enerphit upgrade *breathes new life* into Dublin home

This ambitious and complicated project — a partial upgrade, partial rebuild of an old detached property in south Dublin — is on course to achieve the onerous Enerphit standard for retrofit.

Words: Lenny Antonelli

This retrofit project in south Dublin proved complex, but despite the challenges it ultimately appears to have met the onerous Enerphit standard for low energy retrofit.

The client, who wishes to remain private, had been living in Rathgar, Dublin with his family. With two young children the family wanted more space, but were eager to remain locally. Because the area has been well developed for over a century, buying an old house and renovating was the obvious way forward.

The client spent a few years looking for a suitable property, before buying a 300 square metre early 20th century detached house. Unlike other homes on the street, it was not a protected structure. This made it possible to externally insulate the pebbledash building, thus driving U-values as low as possible and eliminating thermal bridging. But the client was also eager that the retrofit remain sympathetic to the local architectural style.

"Our intent really was to keep the style of the house, keep the shape of the house and everything that actually can be seen from the road — so all of that remained the same, and we just added insulation to the outside," he says. "We were very sympathetic to the original design. It was a modern take on how it looked."

The client, an engineer himself, was intimately involved in the design and build. "At the start we were quite hands on with the level of details," he says. "With any job, if it's passive or not, if you want to influence the outcome you need to be."

He says that minimising the environmental impact of the house was always going to be high on the agenda. "I'm in the business for 25 years, sustainability is a large part of that. We wanted to do something that's true to what we actually do for clients day-to-day. We were never going to do anything that wouldn't be ▶

Photos: Tomasz Juszczak/Imageworks

sustainable. We wanted to take it as far down that route as we could."

But he insists: "To get something that is low energy and environmentally friendly, I don't think you should suffer on comfort —in fact I think your comfort should be enhanced."

Ralph Bingham of Mola Architecture produced the drawings for the planning permission (and later took on the role of project architect during the build). Another architect and passive house designer, Natalie Walsh, was also appointed and produced the working construction drawings, including 16 details related to cold bridging and airtightness. She also found passive house building firm Pat Doran Construction — run by father and son team Pat and Paul Doran — through Passive House Plus magazine.

The client had originally looked at the possibility of meeting the Enerphit standard for retrofit, but thought it would be too expensive, though they still planned to adopt passive house design principles. But when Pat Doran Construction was appointed, they pushed the passive house agenda. "We said it might be possible to do Enerphit without it costing more," says Paul Doran.

He continues: "From our experience and knowledge we were able to say that the budget was sufficient, that the house had a good orientation and form factor for passive house. I'd done a preliminary PHPP [calculation] that showed it met Enerphit requirements and suggested getting Darren O'Gorman [of passive house consultancy Target Zero] involved who confirmed my findings that the house was an excellent candidate for Enerphit."

Paul Doran says that while many builders don't like working in Dublin because of the traffic and lack of space, this house made for a nice change, with its spacious site providing ample room for a site office and small canteen. "It was a brilliant location," he says.

Being a big, old building with lots of different junctions, meeting the Enerphit standards for airtightness and thermal bridging was always going to be the biggest challenge. "There were numerous junction details, and all of them were potentially problems in getting the envelope cold bridge free. On top of that you had all of the services," Paul says.

The house features a wide array of services including automated LED lighting, a security system and audiovisual systems — all of which can be controlled remotely by smartphone app. All mechanical and electrical services including the heating and cooling setup were designed by Ethos Engineering. Ethos spoke to some of their clients who had built near passive buildings, and they reported overheating to be the biggest issue[1] — particularly the length of time it took to cool their dwellings down after returning from time away in summer.

The client points out that while PHPP, the passive house design software, allows homes to go above the overheating threshold of 25C ten per cent of the time, this still equates to about one month a year of overheating. Thus he was keen to have an active cooling system in the

Before, during construction, and after shots of the house; (opposite page, from top) steel column with Compacfoam thermal break; Xtratherm used to insulated upstands; and partial fill board at boundary wall; Quinn Lite thermal blocks at eaves to reduce cold bridging; 25mm Xtratherm PIR sandwiched behind timber to provide continuous insulation from lower roof to external insulation at rear of house; installation of the Kore EPS external insulation; (p75, from top) 100mm Quinntherm PIR insulation at eaves; Isover Metac insulation over the wall plate to help cut thermal bridging; an airtight pocket in the attic; airtight boxes for down lights

house. An outdoor Panasonic air source heat pump provides cooling via a refrigerant delivered to fan coil units in each bedroom (completely separate to the ventilation system). There is a thermostat in each of the bedrooms to control this system, which can also provide heating if necessary.

Separately, a high efficiency condensing gas boiler provides heat to Polytherm underfloor heating pipes downstairs and towel rails upstairs. There's also a solar thermal system to help meet the family's hot water demand. The gas heating and hot water is all regulated by Heat Miser controls, with a touchscreen in the plant room, and can be controlled by smartphone too. And given the size of the house, there are two Zehnder ComfoAir MVHR systems providing fresh, pre-heated air through the house.

"We spent a week figuring out how to get the ventilation system inside the airtight envelope," Paul Doran says. "We did manage it in the end." The semi-rigid ducting used for the manifold, he adds, would have been a nightmare to seal with tapes and membranes otherwise.

The use of a continuous cavity inside the airtight layer helped to contain the services, but there were still lots of penetrations of the airtightness layer at the attic level, because it was more practical to keep the membrane towards the inside of the build-up rather than the outside. "After 100 penetrations I stopped counting," says Paul Doran. "The important thing was not how many there were, just that we caught all of them."

The builders took a number of key steps to make sure the airtight layer remained intact: this included direct site supervision from Paul's father Pat, giving 'toolbox talks' to tradespeople on site, and putting up signs warning people on site to inform the builders if the airtight layer was breached, whether intentionally or by accident. "The worst thing someone could do was drill a hole and not tell us about it," Paul says.

The team removed the chimney stacks completely, cutting out a major cold bridge and source of air infiltration in one swoop. Meanwhile Compac Foam mats supplied by Galway-based company Partel cut out thermal bridging between the seven structural steel beams and the foundations.

While the house is essentially a retrofit, with external EPS insulation to the original brick walls, large sections were rebuilt with concrete blockwork and insulated in the same manner. The footprint of the original building was also extended by about 100 square metres with a single-storey side and rear extension. The roof was also a mixture of new and original parts, all insulated heavily with Isover Metac glasswool.

The old suspended timber floor was removed, and a new concrete poured and insulated with PIR board and finished with polished concrete. There's also thermally broken triple-glazing throughout – in the form of Rationel windows and doors, Reynaers curtain walling, and Fakro roof windows.

The dedication to a highly airtight, continuous thermal envelope posed a threat to the family dogs – as a dog door would have created a significant thermal weak spot. The solution was an automated pet door from Austrian manufacturer Petwalk, which combines access for pets, burglar-proof security and a highly airtight, highly insulated, thermal bridge-free design.

The project involved much more than energy efficiency work though. All internal walls were knocked, and the team completely reconfigured the layout inside, turning the ground floor into a much more open plan, light-filled space. "We were looking for something that flows well, something that was open plan, that suited our way of living," says the client.

His family had only moved into the house nine days before Passive House Plus spoke to him, so it was much too early to ask about the house's performance. But he said: "It's been very pleasant. Other than the usual building problems of living with painters and plumbers and electricians doing the final bits and pieces."

"There's a nice fresh feel in the house," he says. The natural lighting strategy has worked well, with the coloured LEDs — designed to change the mood of the living space — only coming on late in the evening.

Paul's father Pat Doran is happy the team managed to overcome the numerous challenges on site. The project, he says, would have been difficult enough without having to make it airtight. "There was a lot of detail on the roof, and then we had to knock down more than half of the existing building," he says. "It was the most difficult [job] I've done with regards to airtightness and cold bridging."

"Enerphit is special forces training for passive house builders"

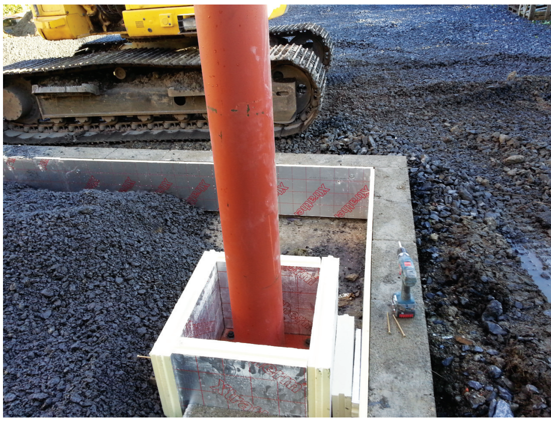
He adds: "All I can really say is that it was difficult, but we got the result we wanted, and I was happy with it."

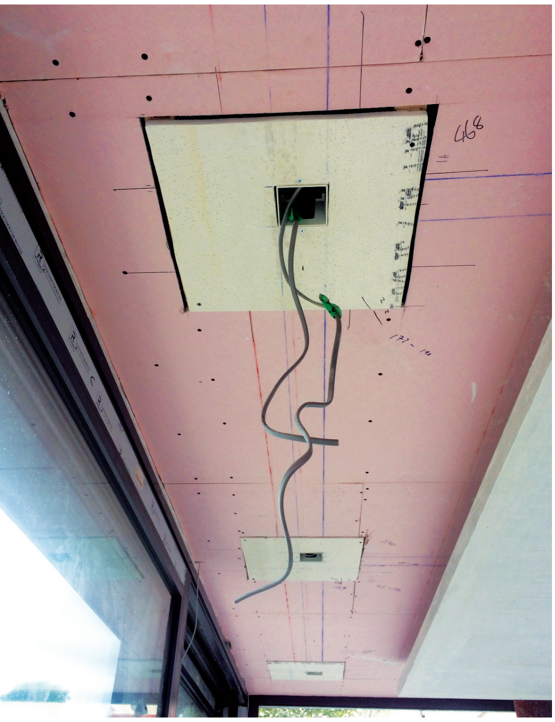
Meanwhile Darren O'Gorman of Target Zero says the final airtightness result of 0.99 air changes per hour is impressive for such a complicated project. "It was a very difficult feat to achieve, particularly with airtightness."

Paul Doran also says that it was the toughest project he's ever worked on from an energy efficiency point of view: "Enerphit is special forces training for passive house builders, and this one was particularly tough."

The project was awaiting Enerphit certification at the time of going to press.

[1]– ed. This appears to be a problem for new homes in general, rather than for passive houses per se. While passive houses are designed to meet maximum average temperature targets, there are no such requirements in Irish or UK building regulations – meaning many highly insulated new homes are being built without regard to whether orientation, form, layout and/or lack of shading will run the risk of causing unacceptably high or low internal temperatures. Similarly, it's possible to use site-specific weather data for passive houses, while the software tools used for Part L compliance for dwellings in Ireland and the UK respectively use data from Dublin Airport and UK average weather data, leading to additional risk of overheating, underheating or higher than anticipated energy use. ▶





PROJECT OVERVIEW:

Building type: 400 square metre two-storey detached house from 1926. Enerphit refurbishment with single-storey side and rear extension

Location: Rathgar, Dublin

Completion date: July 2015

Enerphit certification: pending

BER
Before: D1 (251 kWh/m^2/yr)
After: A2 BER (43.05 kWh/m^2/yr)

Space heating demand (PHPP): 22 kWh/m^2/yr

Heat load (PHPP): 13 W/m^2

Primary energy demand (PHPP): 78 kWh/m^2/yr

Airtightness (at 50 Pascals): 0.99 ACH

Walls
Before: 215mm solid brick walls with no insulation. U-value: 3 W/m^2K
After: 200mm silver aged KORE EPS insulation and acrylic render finish externally, 215mm brickwork, 50mm uninsulated service cavity inside. U-value: 0.15 W/m^2K
Extension walls: 200mm silver aged KORE EPS insulation and acrylic render finish externally, 215mm block wall, 50mm uninsulated service cavity. Two courses of Quinn Lite blocks at floor to wall junction. U-value: 0.15 W/m^2K
Extension boundary wall (adjacent to neighbouring house): 215mm block on flat internally followed outside by 80mm Xtratherm insulation, 20mm ventilated void, and then 100mm block externally. Quinn Lite blocks at top of boundary wall to eliminate thermal bridges. U-value: 0.22 W/m^2K

Roof
Before: Roof slates to sloped areas and torch on felt to flat roof areas externally. No Insulation.
After: (sloped ceiling areas): Blue Bangor slates externally, on counterbattens, on pro clima Solitex breathable membrane with 220mm Metac between rafters, on Siga Majpell airtight membrane stapled to underside of rafters, counterbattens to create a 500 service cavity inside insulated with Metac. U-value: 0.15 W/m^2K
After (flat ceiling areas): Blue Bangor slates on counterbattens, on pro clima Solitex breathable membrane with 400mm Isover Metac above the ceiling joists and 200mm between. Siga Majpell airtight membrane stapled to underside of rafters, counterbattened to create a 25mm uninsulated service cavity. U-value: 0.08 W/m^2K

Existing ground floor: Uninsulated suspended timber floor

Upgraded ground floor and extension floor: Poured concrete onto existing concrete subfloor (brought level with extension floor), 150mm Xtratherm PIR insulation above. Underfloor heating pipes in concrete screed, polished concrete floor finish. U-value: 0.13 W/m^2K

Windows & doors
Before: single-glazed, timber windows and doors. Overall approximate U-value: 3.50 W/m^2K
New triple-glazed windows: Rationel Aura Plus triple-glazed aluclad windows and doors with argon fill and warm-edge spacers: Overall U-value of 0.93 W/m^2K
Sliding doors & curtain walling: Carey Glass 52mm triple-glazing with A-rated warm edged spacer bars. Ug value: 0.7 W/m^2K. Reynaers frames for sliding door & curtain walling with respective Uf values of 2.6 & 2.3 W/m^2K. Overall U-values for sliding doors & curtain walling respectively of 1.1 & 0.90 W/m^2K.
Roof windows: 9 x Fakro FTT U6 thermally broken triple-glazed roof windows with thermally broken timber frames. Overall U-value: 0.80 W/m^2K
Pet door: highly insulated & airtight Petwalk automated door, with frame and door insulated with rigid polyurethane. U-value: 0.5 W/m^2K

Heating
Before: 20 year old oil boiler & radiators throughout entire building
After: Remeha modulating condensing gas boiler, 40 Kingspan solar tubes, underfloor heating to ground floor, and six fan coil units providing cooling to upper floors supplied by a Panasonic heating & refrigeration air source heat pump.
Polytherm underfloor heating system with Heat Miser controls. Heat Miser control system regulates underfloor heating system downstairs and towel rail circuit upstairs, with a thermostat in every room, while also controlling the hot water. Also controllable via a touchscreen interface in the plant room.

Ventilation
Before: no ventilation system. Reliant on infiltration, chimney and opening of windows for air changes.
After: 2 x Zehnder ComfoAir 550 MVHR units — Passive House Institute certified to have heat recovery rate of 84%

SELECTED PROJECT DETAILS
Architect (planning drawings & project supervision): Mola Architecture
Architect (working drawings & passive house details): Natalie Walsh
Contractor: Pat Doran Construction
M&E engineer: Ethos Engineering
Structural engineer: Garland Consultancy
Passive house consultants: Integrated Energy, Target Zero
Passive house certification: Mead Consulting
BER: Rate My Home
Quantity surveyor (client): KMCS
Quantity surveyor (contractor): RTC Surveying
Electrical contractor: Jones Engineering Group
Plumbing: Prospect Plumbing & Heating
Underfloor heating contractor: Base Engineering
Underfloor heating system: Polytherm
MVHR: Flynn Heat Recovery
Air-to-air heat pump: Panasonic
Fan coil units: Tech Refrigeration
Solar thermal: Alternative Energy Ireland
Airtightness testing: Greenbuild
EPS insulation: Airpacks
External render: Neotherm
External insulation contractor: Enda Linnane Construction
Mineral wool insulation: Isover
Airtightness products: Siga
Breather membranes: Ecological Building Systems
Floor insulation: Xtratherm
Thermal breaks: Partel
Low thermal conductivity blocks: Quinnlite
Roof insulation & airtightness contractor: Baker & Co
Windows & doors: Rationel
Curtain walling: Lakeside Windows
Roof windows: Tradecraft
Pet door: Petwalk
Polished concrete floor: Renobuild
Roofing: Christy McMahon Carpentry

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COULD THE DEATH OF ZERO CARBON HELP PASSIVE HOUSE BLOOM?

The Tory government's decision to scrap the proposed zero carbon standard for new dwellings might appear to be a kick in the teeth for green building — but could the move present an opportunity for a better standard to step in?

Words: Peter Rickaby

Amid all the hand-wringing, shirt-rending and kicking of the chancellor's shins that has followed the UK government's scrapping of the proposed zero carbon standard (ZCS) for new dwellings, it is important to reflect on why the standard was proposed, whether the emerging standard fulfilled its promise, and whether scrapping it may not actually be a calamity but an opportunity to do better.

Energy use in dwellings is responsible for at least 25% of UK national greenhouse gas emissions, the rate of replacement of dwellings is around 0.5% per year, and over 80% of the homes we have today will still exist in 2050, so unless we deal with the existing stock there is no chance of meeting our national emissions reduction targets. However, the new dwellings built in any year are responsible for only 0.3% of that year's domestic emissions – the remaining 99.7% are from existing homes, so marginal changes in the energy efficiency of new homes make very little difference overall, at least in the short term.

However, it is a good principle that the many new dwellings that we must build over the next few years should not be allowed to add to the burden of emissions associated with domestic energy use, because reducing the emissions from the existing housing stock is quite challenging enough. Thus the reason for developing the ZCS was essentially symbolic – 'zero carbon' was good political rhetoric, it provided good sound-bites, but most of all it encouraged the house-building industry to rise to the challenge of climate change. Unfortunately the industry failed to do so.

The first mistake was setting the standard at 'zero' (not to mention failing to define what that means). Experience of energy efficiency in buildings taught us long ago that the law of diminishing returns applies – reducing energy use or the associated emissions to zero is hugely more challenging and expensive than reducing them to a lesser but still significant extent. The last 10% of reduction accounts for approximately half the cost, so we need to position our standards optimally on the cost-effectiveness curve. The European Union's forthcoming nearly zero energy building (NZEB) standard acknowledges this, the ZCS did not.

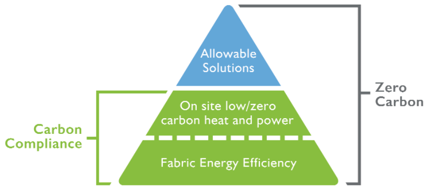
The second mistake was giving the development of the ZCS to the house-building industry, in the guise of the Zero Carbon Hub. At the National Home Energy Rating conference in 1991 Willy Rickett, then undersecretary of the Energy Efficiency Office, remarked that in his experience "the only way to improve the energy performance of new homes is to regulate for it". Nothing has happened since then to suggest that he was wrong – it is difficult to identify any other industry with so little interest in improving the performance of its products except in response to regulation. So giving the zero carbon challenge to the house builders was like offering the poachers the position of gamekeeper. And so it proved: house builders engaged with the Hub did everything they could to resist, dilute and delay the development of the standard. An example of this comes from my experience representing

the RIBA on the Hub's carbon compliance task group. Months of work by more than thirty people culminated in a final, adversarial all-day meeting at which the recommended on-site carbon standard was to be agreed by 4pm. At 7pm we were still there: the house builders were in one room, almost everyone else was in another room, and the chairman was shuttling between them with a notebook, like Henry Kissinger trying to broker peace in the Middle East. An agreement was eventually reached and reported to the Department of Communities and Local Government, but within days the house builders had sought separate meetings with ministers to undermine it. Consequently all the loose ends presented to the minister for guidance or decisions received little or no response.

The ZCS that emerged from this farcical process was inevitably the result of a series of compromises with the house builders and by politicians. Unregulated energy use (associated with cooking, portable lighting and appliances) was excluded. The fabric energy efficiency standard (FEES) was set too low, failing to acknowledge the 'fabric first' approach to sound investment in energy efficiency. Too much reliance was placed on offsetting emissions by means of roof-top solar PV (in some cases the PV panel area exceeded the roof area available). The boundary between the carbon compliance standard (CCS) and off-site 'allowable solutions' was blurred – some house builders saw no need for the CCS, suggesting that FEES and allowable solutions alone were sufficient. The allowable solutions carbon-offsetting scheme emerged as a key component of the ZCS, despite being fiendishly complicated and expensive, practically undeliverable as regulation, and making the viability of housing development highly sensitive to the market price of carbon. Lots of loose ends were left. How to deal with high-rise housing (with not enough roof area for renewables)? Whether to use local or national weather data? Whether to vary the standard regionally to reflect differences in weather? Whether to allow trading-off between dwellings within blocks or within developments? Whether allowable solutions would be a national scheme, or local schemes administered by local authorities or companies, or internal to housing organisations (thus providing funding for retrofit) or internal to house builders? How to sell new 'zero carbon' homes to purchasers who would subsequently receive substantial energy bills?

Technically, the ZCS was never well-founded in building physics or practical experience. Most of the analyses were based on modelling with a modified version of the Sap energy rating software (decried by some as "merely a compliance tool") rather than with a more robust dynamic model, or even PHPP. Promotion of the ZCS as an as-built standard rather than a design standard resulted in a costly, time-consuming and largely unproductive diversion to investigate the so-called 'performance gap' but ignored the problem of how as-built performance could be distinguished, cost-effectively, from as-occupied performance. Meanwhile the critical role of ventilation in well-insulated, airtight dwellings and the significant risk of summer overheating were acknowledged and investigated too late in the day, and not adequately resolved.

Against this background, the politically adept house building industry saw an opportunity in the recent election of a Conservative government to argue that the ZCS was too complex



The zero carbon standard proposed to cut the carbon emissions of dwellings to zero via a combination of fabric energy efficiency measures, renewable and low carbon onsite energy generation and, most controversially, the offsetting of the remaining carbon emissions via the so-called allowable solutions.

and expensive, and would inhibit the much clearer political objective of building a very large number of new homes as quickly as possible. It is hardly surprising that the government then looked at the technical weakness, complexity and cost of the ZCS and quickly decided to scrap it.

Where does this leave us? Rather than bemoaning the loss of an unsound and undeliverable standard, we should be grasping the opportunity to promote a better one. Unless the UK decides to withdraw from the European Union after the referendum in 2017, we will be obliged to implement the NZEB standard for all new buildings by 2020. Thus we have five years to develop, promote and establish a simple, technically robust and cost-effective standard that is deliverable as regulation, and to present it to the government, after 2017, as a solution to their European obligation rather than a problem. We should not mourn for the lost ZCS but treat it as a learning experience, at every level.

should be promoting the passive house standard as a 'deemed to satisfy' alternative to whatever NZEB standard emerges, so that architects and progressive house builders will have a choice of compliance methods. We should not underestimate the challenge: I remember a suggestion that passive house might have something to offer, made at a meeting of the Hub's energy work group, resulting in rolling eyes and a sharp intake of breath around the table. Some of those present were engaged with the Hub in order to avoid the imposition of a standard they saw as too complex and too expensive. Does that sound familiar? Technical and political re-education and rehabilitation are required.

One positive outcome of the ZCS debacle is that the manufacturers and suppliers of building materials and products have been gearing up to supply the industry with the components needed for energy efficient homes: insulation, high performance windows, ventilation systems, etc. Many of these organisations serve the European market, so their investment and innovation have been driven as much by the NZEB standard as by the ZCS, and will not be lost. However, suppliers and their investors need to be reassured that there will be a market here for products that help to deliver energy efficiency. We also need to avoid becoming the dumping-ground for obsolete end-of-line products that do not meet forthcoming European standards but might find a less exacting market here; this happened with domestic boilers when the SEDBUK efficiency standard was introduced in England and Wales – the stock of non-compliant boilers

> "Giving the zero carbon challenge to the house builders was like offering the poachers the position of gamekeeper."

The passive house standard is very well placed to at least form the basis of the standard we eventually adopt, if not to become the standard itself. It is based on building physics, practical experience and monitored performance, and it is underpinned by sound (if somewhat clunky) design and compliance assessment software in PHPP. It includes challenging but realistic targets for primary energy use, space heating demand, ventilation air change rate, internal temperature, fabric insulation, airtightness and thermal bridging, and it demands evidence about how those targets will be met. There is an emerging infrastructure of design, assessment and certification experience and expertise, which could be developed and adapted locally in response to the 'not invented here' syndrome. Most importantly, the passive house standard is an as-built standard that doesn't come with a performance gap, a ventilation blind-spot or a significant overheating risk – all of those issues are taken into account and dealt with in a technically robust way. The strength of the passive house approach is that it recognises that the performance gap is in reality an 'attention to detail deficit' that runs through the design and construction process. The passive house approach, supported by PHPP, identifies the details that are important and forces both the designer and the builder to pay attention to them.

There is much now to do to make the passive house standard (or something very similar) palatable to politicians, house builders and the house-buying public. At the very least we

was quickly exported to Scotland and Ireland.

For the immediate future, the NZEB comes with an 'optimality test' of cost-effectiveness, and some people in the industry are already suggesting that current building regulations standards pass that test, so nothing more is needed. The first objective should be to dispel that myth. There is plenty of evidence that new homes can be built to the passive house standard within the usual cost limits for social housing, so it ought to be cost-effective for house builders to do that as well.

Paraphrasing Churchill's famous words, the demise of the zero carbon standard is not the beginning of the end for energy efficiency in new buildings, but it might just be the end of the beginning. There are more battles to fight, and the industry should look forward, with a view to presenting the chancellor with solutions to emerging problems rather than admonishing him for taking a decision that couldn't realistically have been different.

Peter Rickaby is director of Rickaby Thompson Associates energy + sustainability consultants, a non-executive director of the Centre of Refurbishment Excellence (CoRE) a member of the board of trustees of the National Energy Foundation (NEF) and a recently retired member of the RIBA sustainable futures group. The views expressed in this article are his own and do not necessarily reflect the views of CoRE, the NEF or the RIBA.